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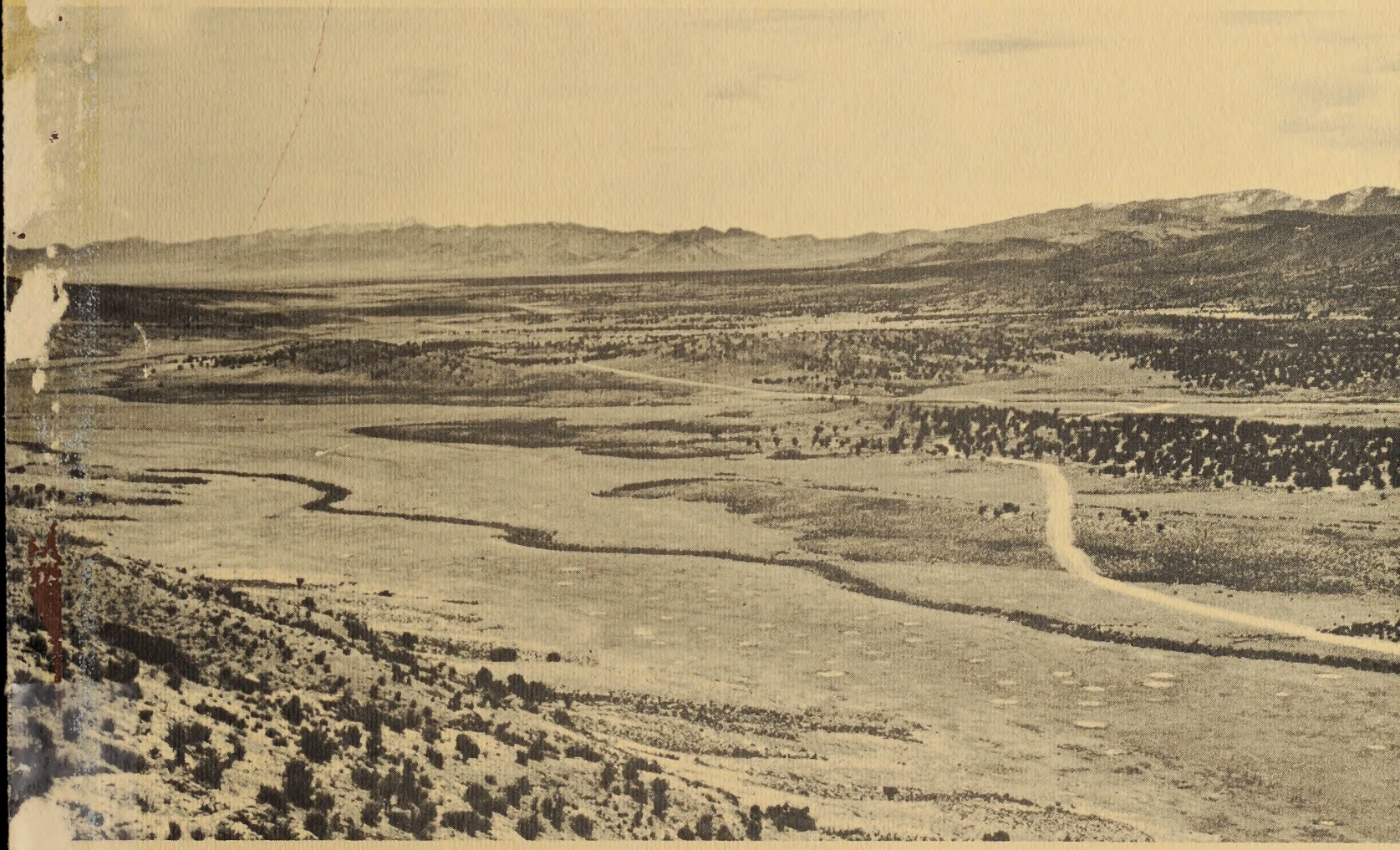
MAY, 1968

VEGETATION AND SOILS OF THE DUCKWATER WATERSHED

Wilbert H. Blackburn Paul T. Tueller Richard E. Eckert, Jr.



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UNIVERSITY OF NEVADA
DALE W. BOHMONT, DEAN AND DIRECTOR
In Cooperation With
U.S. DEPARTMENT OF INTERIOR — BUREAU OF LAND MANAGEMENT

ACKNOWLEDGMENTS

The authors wish to express appreciation to Frederick F. Peterson, University of Nevada, Lucien Langan and Edmund A. Naphan, Soil Conservation Service, for their guidance and helpful comments with the soils.

We wish to thank all those people who have been of assistance by making suggestions, reviewing portions of the manuscript or helping with the field work.

VEGETATION AND SOILS

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DUCKWATER WATERSHED

Wilbert H. Blackburn[1/], Paul T. Tueller[1/],
and Richard E. Eckert, Jr.[2/]

[1/]Junior Range Ecologist and Associate Range Ecologist, Nevada Agricultural Experiment Station, Reno, Nevada.

[2/]Range Scientist, Crops Research Division, Agricultural Research Service, U.S.Department of Agriculture, Reno.

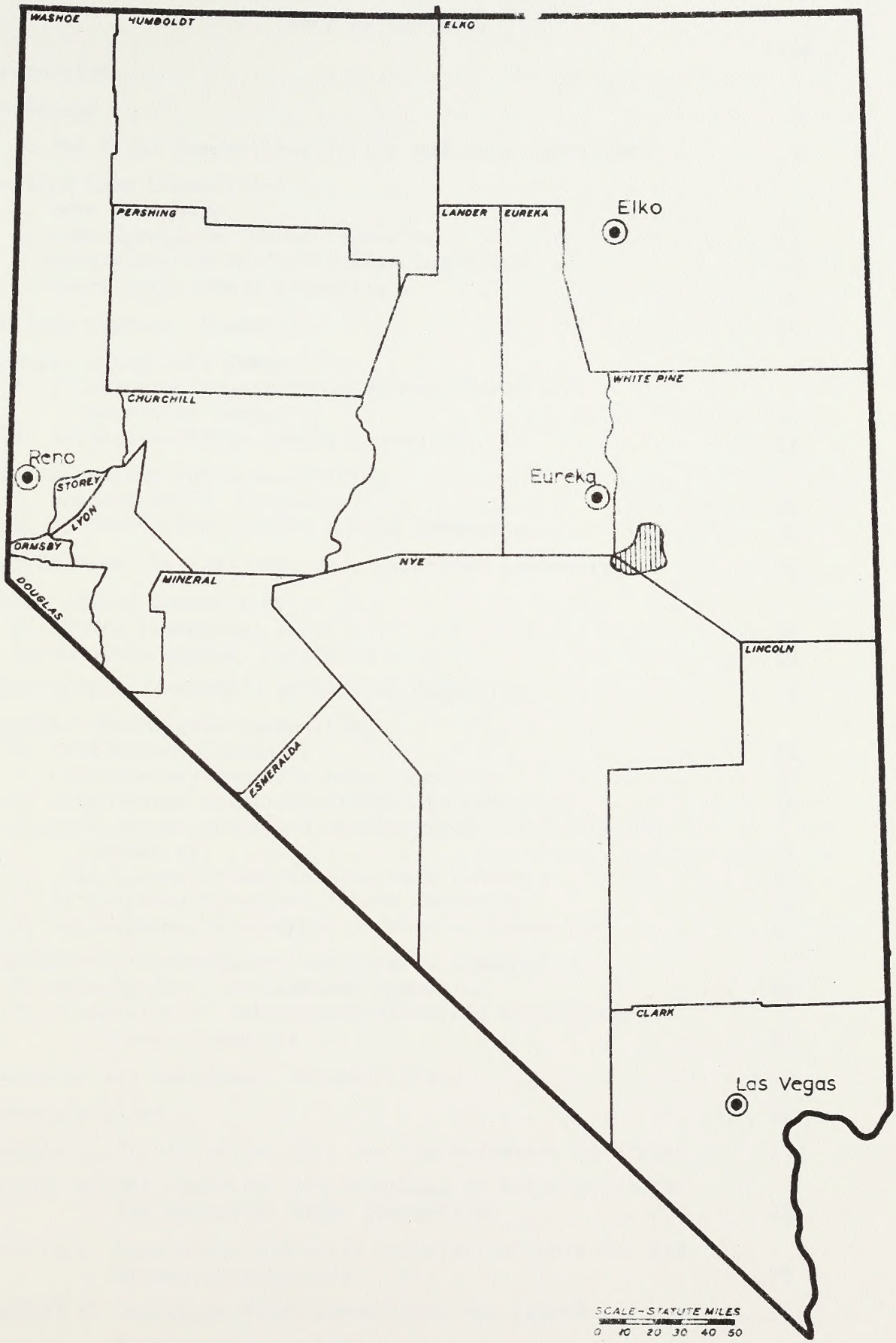

Figure 1. ▨ Location of the Duckwater Watershed in Nevada

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INTRODUCTION

The Duckwater Watershed is located about 30 airline miles south and a little east of Eureka, Nevada and is mostly in White Pine County with a small portion in Nye County (Fig. 1). The basin includes approximately 100 square miles.

The watershed lies near the center of the Great Basin within the Basin and Range physiographic province and consists of north-south trending mountains separated by small valleys. The altitude of the highest peak is about 7300 feet and the basin outlet is approximately 5800 feet. Relief between the mountains and adjoining valleys rarely exceeds 1400 feet.

Geologic parent materials consist mainly of tuff, basalt and andesite, with smaller amounts of limestone, conglomerate, shale and dolomite. Valley fill consists mainly of alluvium.

Free water of the basin flows briefly in ephemeral streams resulting from snow melt or thunderstorms. No perennial streams or springs are found in the watershed, however, a few man made ponds trap water for livestock use.

The climate of the watershed is arid. Annual precipitation for a 3-year period ranged from 7.8 to 13.7 inches. Comparisons with known records in the same general area (Austin, Ely and McGill stations) indicated two near average and one above average precipitation years. During the period 1949 to 1964, the approximate temperature at the lower elevations of the basin ranged from a low of -34°F to a high of 99°F with the average annual temperature rarely exceeding 43°F.

Three vegetative zones are represented in the watershed. These are: salt desert shrub, northern desert shrub (sagebrush) and pinyon and juniper. The soils are mostly Aridisols with a few Entisols and Mollisols.

Land use consists primarily of livestock grazing. Livestock have been associated with depletion of grass and browse stands, and the invasion or increase of undesirable plants. The result has been an apparent decrease in forage production in the basin.

Land managers constantly require factual information upon which to base their programs. There is a special need for detailed data concerning vegetation and soils on range lands. Material included in this report describes the climax and seral units of vegetation and associated soils in the Duckwater watershed. It is one of the 12 range watershed study areas in Nevada administered by the U. S. Department of the Interior, Bureau of Land Management. The vegetation-soil analysis herein reported is a portion of a cooperative research effort between the Bureau of Land Management and the Renewable Resources Center of the University of Nevada.

This study was designed as a multiple-purpose ecological inventory of vegetation and soil resources. The study provides fundamental information which can be interpreted and re-interpreted as use patterns change and as understanding increases without the need for a complete re-survey as new uses are emphasized.

The value of the data outlined in this report lies in the development of relationships between vegetation and soil and the resultant indicator significance of vegetation. For example, a classification of the basic ecological units is necessary for a thorough understanding of the landscape and for interpretation of site potential. However, site potential for a given vegetation-soil grouping requires further analysis and the accumulation of data about the value of a management practice if it were applied to the grouping in question. Much of this data is not yet available. Any management recommendation made in this report is curtailed due to a lack of data relating to vegetation-soil groupings described herein. When such data become available, however, the land manager will be able to easily identify sites within the confines of his unit of responsibility upon which a given practice or management program has been found to be desirable. An enhanced ability to precisely define range landscapes constitutes the real value of this analysis.

In this study we have attempted to define the vegetation-soil groupings on the basis of a habitat-type classification. A habitat-type, as defined by Daubenmire (1952) is "the collective area which is capable of supporting the same homogeneous climax plant association." Collective area means a unique ecological entity which can be delineated on a map or aerial photograph. The habitat-type concept indexes site potential since it is an expression of the ultimate unit of the sum environment with regard to vegetation, soil classification unit, topographic placement and by inference micro- and mesoclimatic factors.

As an example, we have interpreted the *Artemisia tridentata/Agropyron inerme* community to be a habitat-type based on its homogeneity, recurrence, productivity, relict areas and apparent equilibrium with its environment. When a community is not climax, careful evaluation of plant, soil, physiographic and climatological data is necessary in order to speculate as to the probable habitat-type with its specific potential. The *Descurainia sophia* community is an example of seral vegetation. Remnant *Eurotia lanata* (winterfat) plants were found in this community and it occurred on the same soil with the same physiographic placement and similar climate as winterfat stands found elsewhere within the basin. On these bases the *Descuraina sophia* community was interpreted to be a *Eurotia lanata* habitat-type. Similar evaluations have been made for most of the communities recognized in the watershed.

The first section of this report is a dichotomous key to the 22 plant communities. This key refers the reader to the second section, a detailed description of each community. The third section is devoted to a discussion and management suitabilities for the watershed. This is followed by the appendices which consists of precipitation data, soil families and sub-groups as associated with the watershed plant communities, vegetation and soil association table, and Duckwater plant communities

legend. Finally a watershed map illustrates mapping units which consists of plant communities with their respective percentage indicated; major drainages; roads; precipitation gages; townships, ranges and sections.

METHODOLOGY

The vegetation of the Duckwater Watershed was delineated into plant communities during a reconnaissance. As a general rule, all communities were recognized and delineated on the basis of vegetative characteristics alone. Then as soil and physiographic data were accumulated, this initial delineation was re-evaluated on several occasions until the 22 plant communities described in this report were finally identified and interpreted. These communities were given names corresponding to the major dominant and major sub-dominant species.

Tree Crown Cover Data

Crown cover data of trees were obtained from a 66- x 132-foot plot. Trees found within the plots were counted by species and 10 typical tree crowns were measured. From this information the average tree cover was computed for each species by plot.

Basal Area and Cover Data

After the plant communities were delineated, an intensive study was initiated by an adaptation of methods described by Poulton and Tisdale (1961) and further modified by Tueller (1962).

A 100-foot-square macroplot was used. Five plots were considered ample to adequately describe a community (Eckert, 1957) but on minor or inaccessible communities, only one or two plots were used.

Permanent macroplots were established by running a 100-foot baseline up and down the slope. Plots placed on the level were oriented north and south.

Within each macroplot, four 4- x 50-foot belt transects were randomly located perpendicular to the baseline. Randomization was restricted to prevent transect overlap and to provide for two transects each in the upper and lower half of the plots. This two-way randomization provides for adequate sampling of the full length of the macroplot (Eckert, 1957).

Each belt transect was divided into ten 4- x 5-foot plots thus enabling forty 4- x 5-foot plots to be studied in each macroplot. Two kinds of data were obtained from each plot: (1) basal area of the more abundant grasses and herbs, and (2) crown cover estimates of shrubs. A one-square-foot frame was used as an estimation guide for both basal area and crown cover data.

Basal area was selected because it is relatively free from yearly weather variations and grazing influences (Tueller, 1962). Dead centers which exceeded 25 percent of the area of bunchgrasses were excluded from the estimate. Basal area estimates by species were based on the following cover classes (Poulton, 1962):

Class	Class Range Percent	Midpoint Percent
1	0 - 1	0.5
2	1+ - 5	2.5
3	5+ - 10	7.5
4	10+ - 25	17.5
5	25+ - 50	37.5
6	50+ - 75	62.5
7	75+ - 95	85.0
8	95+ - 100	97.5

The midpoint of each class range was used in calculating cover percentage.

Shrub crown cover estimates were obtained by standing directly over the shrub and projecting the foliage cover onto the ground. Estimates were made for each species to the nearest 1 percent of the 4- x 5-foot plot. Openings in the canopy larger than one-quarter of a square foot were not included.

Frequency Data

Frequency, according to Cain and Castro (1959), is percent presence in plots of a stated size. For example, if a sample of a stand consists of 200 plots, and if one or more plants of a given species occurs in 50 of these plots, the species has a frequency percentage of 25.

Frequency sampling procedures developed by Hyder et al. (1963) were used to supplement cover estimates in each macroplot. Although frequency data are difficult to interpret, the speed and objectivity inherent in the method makes them useful when comparing areas where high statistical precision is needed (Tueller, 1962). Ten frequency transects, each with 20 presence or absence determination quadrats, were located perpendicular to the baseline. Each transect consisted of twenty 20- x 20-inch, 30- x 30-inch, 12- x 24-inch, or 3- x 3-inch quadrats placed contiguously and moving away from the baseline. Only those plants rooted inside the frequency quadrats were recorded. A two-stage randomization was applied to these transects: (1) restricting five transects to each half of the macroplot, and (2) preventing transect overlap.

Non-living Ground Cover

Non-living ground cover was determined by an adaptation of the point frame method as described by Goddall (1952). The same 200 frequency plots were used to sample cover but instead of recording presence of vegetation, the bottom tip end of the frequency frame was used as a point. Hits of bare ground, litter, pavement (1/4 to 1-inch diameter) and rock (1-inch plus diameter) were recorded.

Constancy

Cain and Castro (1959) define constancy as "the percentage of occurrence of a species on samples of the same size in various stands of a community type."

Species constancy percentages were calculated for each community. In order to develop a complete species list for constancy, each 100- x 100-square-foot macroplot was examined carefully after obtaining cover and frequency data, additional species encountered were added to the list.

Topographic and Physiographic Features

Topographic features of each macroplot were characterized as follows: position on the slope whether top, upper one-third, center one-third, lower one-third, or bottom; slope in percent obtained from an abney level; and aspect from an 8-point compass.

Physiographic placement of each macroplot was characterized as follows: land form -- drainage bottom, escarpment, fan, floodplain, plateau, flooded depression, ridge top, slope, lake-marine, or river terrace; macrorelief -- flat, undulating, rolling, butte, hilly, or mountainous; microrelief -- uniform, flat, convex, concave, interrupted, mound, pits, ridge and swale.

Soils Study

A soil profile description was made at each macroplot using the procedures outlined in the Soil Survey Manual (1951) and the Seventh Approximation (1960) plus revisions (1967). Horizons, soil color, texture, pH, lime content, structure, and consistence were noted for each profile.

Lack of time and money prevented complete laboratory soil analyses. The following parameters were selected because they have been suggested to be indicative of vegetation and soil relationships (Eckert, 1957). Samples from the A_1 and B_2 horizons were analyzed for conductivity (millimhos per centimeter), pH (from a saturaged paste), and organic matter (percent). Cation exchange capacity (milliequivalents per 100 grams) was determined only on those samples from the A_1 horizon (USDA Handbook No. 60, 1954).

Family level identifications were made as found in the Seventh Approximation (1960) and revisions (1967). When more than one profile description per family occurred, the model description was used noting that family.

Each soil was classified as to hydrologic group (Nevada Dept. of Conservation and Natural Resources and the USDA, 1965); stoniness (USDA, 1951); and estimated water holding capacity based on clay mineralogy and texture (Schockley,1955). Available water holding capacity was estimated for the rooting depth or to the depth of the soil profile studied if not otherwise stated. Rooting depths were limited by duripans and lithic or paralithic contacts.

Soil boundaries were not physically located and a soil map was not made. Thus detailed comparisons of soils across the boundary were not possible or within the scope of this study. Only the soils at the

macroplots were described. The kinds of soils noted at the macroplots are probably commonly associated with the different kinds of vegetation in this watershed.

Climatic Data

Precipitation data were taken for a 3-year period from non-recording rain gages placed throughout the watershed. The data were then related to each applicable community in inches of annual precipitation.

Temperatures were estimated from existing records at the Fish Creek Ranch located about 15 miles to the west. It has a climate similar to that of the lower elevations of the watershed.

Statistical Analysis

Confidence limits (CL) were calculated for the highly constant species in those communities sampled with four or more macroplots and were used to judge the significance of data differences.

KEY TO THE PLANT COMMUNITIES IN THE DUCKWATER WATERSHED

A. Communities with a pigmy conifer overstory (pinyon-juniper).

B. Communities with pure *Juniperus osteosperma* overstory.

C. *Juniperus osteosperma* forming a closed community -- . . . . . *Juniperus osteosperma* community (p.35).

CC. *Juniperus osteosperma* not forming a closed community

D. One species dominating the understory. Less than 3-percent rock cover.

E. *Artemisia nova* dominating the understory -- *Juniperus osteosperma/Artemisia nova* community (p.37).

EE. *Artemisia tridentata* dominating the understory -- *Juniperus osteosperma/Artemisia tridentata* Community. . . . . (p.39).

EEE. *Agropyron inerme* dominating the understory -- *Juniperus osteosperma/Agropyron inerme* community . . . . . (p. 45).

DD. Same as above but 30 percent or more rock cover.

E. *Artemisia nova* dominating the understory -- *Juniperus osteosperma/Artemisia nova*/rock community . . . . . (p. 43).

EE. *Cercoparpus intricatus* dominating the understory -- *Juniperus osteosperma/Cercocarpus intricatus* community . . . . . (p. 47).

DDD. More than one species dominating the understory. Less than 3-percent rock cover.

E. *Artemisia nova* and *Atriplex confertifolia* sharing dominance -- *Juniperus osteosperma/Artemisia nova/ Atriplex confertifolia* community . . . . . (p. 41).

BB. Communities with a *Pinus monophylla* and *Juniperus osteosperma* overstory.

C. *Pinus monophylla* and *Juniperus osteosperma* sharing dominance with very little understory vegetation -- *Pinus monophylla/ Juniperus osteosperma* community . . . . . (p. 49).

CC. *Pinus monophylla* and *Juniperus osteosperma* sharing overstory dominance with *Artemisia nova* and *Agropyron inerme* forming an understory -- *Pinus monophylla/Juniperus osteosperma/Artemisia nova/Agropyron inerme* community. . (p. 51).

AA. Community <u>without</u> a pigmy conifer overstory (pinyon-juniper).

B. Communities dominated by sagebrush (*Artemisia*).

C. Communities dominated by *Artemisia nova*.

D. Communities usually with less than 2 percent grass cover in the understory.

E. *Artemisia nova* the dominant --*Artemisia nova* community. . . . . (p. 10).

EE. Same as above but with *Atriplex confertifolia* being fairly abundant -- *Artemisia nova/Atriplex confertifolia* community . . . . . (p. 14).

DD. Communities usually with more than 2 percent grass cover in the understory.

E. Community with *Agropyron inerme* forming an understory below the sagebrush -- *Artemisia nova/Agropyron inerme* community . . . . . (p. 12).

EE. Community with *Stipa comata* forming an understory below the sagebrush -- *Artemisia nova/Stipa comata* community. . . . . (p. 16).

CC. Communities dominated by *Artemisia tridentata*.

D. *Artemisia tridentata* dominating the vegetation with *Chrysothamnus viscidiflorus* var. *puberulus* forming a secondary dominant -- *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* community . . . . . (p. 20).

DD. *Artemisia tridentata* dominating the vegetation with *Stipa comata* forming an understory below the sagebrush -- *Artemisia tridentata/Stipa comata* community. . . . . (p. 22).

CCC. Communities dominated by *Artemisia pygmaea*.

D. *Artemisia pygmaea* the dominate -- *Artemisia pygmaea* community . . . . . (p. 18).

BB. Communities not dominated by sagebrush (*Artemisia*).

C. Communities dominated by *Atriplex confertifolia*.

D. *Atriplex confertifolia* the dominant -- *Atriplex confertifolia* community . . . . . (p.24).

DD. *Atriplex confertifolia* and *Eurotia lanata* co-dominates -- *Atriplex confertifolia/Eurotia lanata* community. (p. 26).

C. Communities not dominated by *Atriplex confertifolia*.

D. Community dominated by *Chrysothamnus viscidiflorus* var. *puberulus* - - *Chrysothamnus viscidiflorus* var. *puberulus* community . . . . . (p. 28).

DD. Communities dominated by *Eurotia lanata* -- *Eurotia lanata* community . . . . . (p. 30).

DDD. Communities dominated by *Grayia spinosa* -- *Grayia spinosa/Artemisia spinescens* community . . . . (p. 33).

DDDD. Communities dominated by *Descurinia sophia* -- *Descurinia sophia* community . . . . . (p. 32).

Black Sagebrush (*Artemisia nova*) Communities

1. *Artemisia nova* Community

This community is found in most parts of the watershed. At the higher elevations it is usually found on ridges as inclusions within *Juniperus osteosperma/A. nova*. Frequently on north slopes *A. nova/Agropyron inerme* occurs as inclusions within this community, and in some drainages *A. nova* alternates with *Eurotia lanata*. At lower elevations it occurs as inclusions in *Chrysothamnus viscidiflorus* var. *puberulus* or *Artemisia nova/Atriplex confertifolia* communities.

This community receives from 8.0 to 11.9 inches of precipitation per year (rain cans 1, 5, 12, 21, 22, and 23, Appendix A). Elevation ranges from 5900 to 6550 feet. Aspect is usually northwest but may be east or west. Slope is 2 to 7 percent.

Black sagebrush *(A. nova)* is fairly frequent and provides dominant cover in the overstory. *C. viscidiflorus* var. *puberulus* is present but in much smaller amounts. Indian ricegrass *(Oryzopsis hymenoides)* is highly constant but contributes little to frequency or cover and is usually found in low vigor. This grass may have been dominant in the original understory and has decreased due to grazing. A variety of invader species such as halogeton *(Halogeton glomeratus)*, Russian thistle *(Salsola kali* var.*tenuifolia)* found in parts of the community indicates a deteriorated condition. Plants such as globemallow (*Sphaeralcea coccinea)*, shadscale (*A. confertifolia)*, spiny hopsage (*Grayia spinosa)*, bud sagebrush (*Artemisia spinescens)*, winterfat (*Eurotia lanata)*, and summer cypress (*Kochia americana)* are present in varied amounts throughout the lower elevations of the community (Table 1). This community is probably an *Artemisia nova/Oryzopsis hymenoides* habitat-type.

Litter cover is fairly high. The rest of the non-living ground cover is mostly pavement with some bare ground and a small amount of rock (Table 2).

The soil at the macroplots where this vegetation was sampled is a member of a coarse-loamy, mixed, frigid family of Mollic Durorthids (Appendix B-17).

Table 1. Species Cover, Frequency and Constancy for the *Artemisia nova* Community

Species	Cover % CL***	20 x 20* Frequency % CL	Constancy %
Artemisia nova	12.8 ± 2.2	50.7 ± 22.6	100
Sphaeralcea coccinea	t**	31.7	50
Chrysothamnus viscidiflorus var.*puberulus*	1.2	16.6	100
Halogeton glomeratus	1.1	16.6	66
Oryzopsis hymenoides	t	7.2	100
Sitanion hystrix	t	5.3	66
Agropyron spicatum	t	t	50
Atriplex confertifolia	t	t	50
Grayia spinosa	t	t	50
Kochia americana	t	t	33
Poa secunda	t	t	33
Artemisia tridentata	t	t	16
Astragalus deflexum	t	t	16
Chenopodium leptophyllum	t	t	16
Collinsia parviflora	t	t	16
Crepis acuminata	t	t	16
Elymus cinereus	t	t	16
Ephedra nevadensis	t	t	16
Eriogonum heermannii	t	t	16
Eurotia lanata	t	t	16
Hilaria jamesii	t	t	16
Opuntia polyacantha	t	t	16
Salsola kali var. *tenuifolia*	t	t	16
Tetradymia spinosa	t	t	16

* Frame size in inches
** Trace
*** Confidence Limits

Table 2. Non-living Ground Cover Characteristics for the *Artemisia nova* Community

Material	Cover % CL
Bare ground	14.0 ± 9.6
Litter	26.6 ± 13.1
Pavement	52.1 ± 17.2
Rock	7.3

2. *Artemisia nova/Agropyron inerme* Community

This community is located mostly in the western part of the watershed and occurs on steep north or east facing slopes. It also occurs as a pure type or with a scattered *Juniperus osteosperma* overstory.

This community receives from 10.4 to 11.9 inches of precipitation per year (rain cans 19, 21, and 23, Appendix A). Elevation is 6125 to 6650 feet. Aspect is north or east. Slope is 36 percent.

Black sagebrush *(A. nova)* is the dominant shrub. Although rabbitbrush (*C. viscidiflorus* var. *puberulus*) and spiny hopsage (*Grayia spinosa*) are found throughout the community, they contribute very little to cover or frequency. Beardless bluebunch wheatgrass (*Agropyron inerme*) is the predominant grass and has a higher frequency and cover than *A. nova*. Sandberg bluegrass (*Poa secunda)*, a low producer, occurs in small amounts; Indian ricegrass (*Oryzopsis hymenoides)* and galleta grass (*Hilaria jamesii*), high producers, are found in trace amounts (Table 3). The data suggest that this community is an *Artemisia nova/Agropyron inerme* habitat-type.

Rock cover makes up more than one-half of the non-living ground cover material. The high density of grasses and sagebrush accounts for the relatively high litter cover. Pavement and bare ground is sparce (Table 4).

The soil at the macroplots where this vegetation was sampled is a member of a loamy-skeletal, mixed, frigid family of Mollic Haplargids (Appendix B-21).

Table 3. Species Cover and Frequency for the *Artemisia nova/Agropyron inerme* Community

Species	Cover %	20 x 20* Frequency %
Artemisia nova	3.2	25.0
Agropyron inerme	7.8	64.0
Poa secunda	t	22.5
Sphaeralcea coccinea	t	5.0
Chrysothamnus viscidiflorus var. *puberulus*	t	3.5
Grayia spinosa	t	3.0
Oryzopsis hymenoides	t	1.5
Hilaria jamesii	t	1.5
Cryptantha jamesii	t	0.5

* Frame size in inches

Table 4. Non-living Ground Cover Characteristics for the *Artemisia nova/Agropyron inerme* Community

Material	Cover %
Bare ground	9.0
Litter	25.5
Pavement	8.5
Rock	57.0

3. *Artemisia nova/Atriplex confertifolia* Community

This community is encountered in the eastern part of the watershed where it usually occurs at higher elevations associated with *Juniperus osteosperma/A. nova/A. confertifolia* community. At lower elevations it is found as inclusions within the *A. nova* community or as a small pure type.

The community receives from 8.4 to 11.0 inches of precipitation per year (rain cans 3, 4, and 9, Appendix A). Elevation ranges from 5850 feet to 6600 feet. Aspect is usually west but can be north or east. Slope is 3 to 16 percent.

Black sagebrush (*A. nova*) dominates the vegetation. Shadscale (*A. confertifolia*) is found in a much smaller quantity but is dispersed uniformly throughout the community. Rabbitbrush (*C. viscidiflorus* var. *puberulus*) is as frequent as shadscale but it is very erratic in its occurrence. Indian ricegrass (*Oryzopsis hymenoides*) and squirreltail (*Sitanion hystrix*) are highly constant but contribute little to cover or frequency. Spiny hopsage (*Grayia spinosa*) is dispersed throughout the community in very small amounts and halogeton (*Halogeton glomeratus*) has invaded the community to a limited degree (Table 5). This community on the coarse-loamy, mixed, frigid family of the Entic Mollic Durorthids soil is probably an *A. nova* habitat-type. On the other soils *A. confertifolia* has probably increased due to overgrazing of *A. nova*.

Pavement is accountable for 37.6 percent, litter for 32.2 percent of the non-living ground cover. The remaining cover is shared by rock and bare ground (Table 6).

The soiis at the macroplots where this vegetation was sampled are members of a coarse-loamy, mixed, frigid family of Entic Mollic Durorthids (Appendix B-14); loamy -skeletal, mixed, frigid family of Typic Calciorthids (Appendix B-4); or fine-loamy, mixed, frigid family of Mollic Durargids (Appendix B-24).

Table 5. Species Cover, Frequency and Constancy for the *Artemisia nova/Atriplex confertifolia* Community

Species	Cover % CL	20/20 Frequency % CL	Constancy %
Artemisia nova	9.8 ± 2.8	63.6 ± 21.5	100
Chrysothamnus viscidiflorus var. *puberulus*	1.9	14.1	100
Atriplex confertifolia	2.0 ± 0.8	12.4 ± 5.5	100
Oryzopsis hymenoides	t	6.1	100
Sitanion hystrix	t	5.0	100
Stipa comata	t	5.0	20
Halogeton glomeratus	t	3.5	60
Collinsia parviflora	t	2.9	40
Grayia spinosa	t	2.1	80
Eurotia lanata	t	2.0	20
Artemisia spinescens	t	t	60
Sphaeralcea coccinea	t	t	60
Opuntia parishii	t	t	40
Poa secunda	t	t	40
Tetradymia glabrata	t	t	40
Astragalus purshii	t	t	20
Caulanthus crassicaulis	t	t	20
Chaenactis douglasii	t	t	20
Crypthantha jamesii	t	t	20
Echinocactus simpsonii	t	t	20
Ephedra nevadensis	t	t	20
Kochia americana	t	t	20

Table 6. Non-living Ground Cover Characteristics for the *Artemisia nova/Atriplex confertifolia* Community

Material	Cover %
Bare ground	11.1 $\pm^{CL}$ 11.1
Litter	32.2 $\pm$ 10.5
Pavement	37.6 $\pm$ 25.7
Rock	19.0

4. *Artemisia nova/Stipa comata* Community

This community is encountered in the southwest part of the watershed and usually on the steeper south facing slopes. *Juniperus osteosperma/A. nova* community is usually found at the higher elevations and *Artemisia tridentata/Stipa comata* or *A. tridentata/C. viscidiflorus* var. *puberulus* communities at the lower elevations.

This community receives an annual precipitation of 11.2 to 11.9 inches (rain cans 21 and 23, Appendix A). Elevation ranges from 6400 to 6550 feet. Aspect is usually south. Slope is 13 to 24 percent.

Black sagebrush *(A. nova)* is the dominant shrub and occurs uniformly throughout the community. Rabbitbrush (*C. viscidiflorus* var. *puberulus)* has equal frequency but is rather erratic in occurrence and expresses lower cover. Needle-and-thread grass (*S. comata*) is present in large amounts, galleta grass (*Hilaria jamesii*) is less common and Sandberg bluegrass (*Poa secunda*), squirreltail grass (*Sitanion hystrix*), Indian ricegrass (*Oryzopsis hymenoides*) are sparce (Table 7). This community is probably an *Artemisia nova/Stipa comata* habitat-type.

The large quantity of grass and shrubs account for a good cover of litter. Rock and pavement are also fairly high with a small amount of bare ground (Table 8).

The soil of the macroplots where this vegetation was sampled is a member of a fine-loamy, mixed, frigid family of Mollic Haplargids (Appendix B-20).

Table 7. Species Cover and Frequency for the *Artemisia nova/Stipa comata* Community.

Species	Cover %	20/20 Frequency %
Stipa comata	2.7	76.8
Chrysothamnus viscidiflorus var. *puberulus*	2.9	24.0
Artemisia nova	4.3	23.8
Hilaria jamesii	1.6	6.0
Sitanion hystrix	t	6.0
Grayia spinosa	t	2.8
Poa secunda	t	0.8
Arabis sp.	t	0.8
Astragalus purshii	t	0.5
Oryzopsis hymenoides	t	0.5
Sphaeralcea coccinea	t	0.5
Aster scopulorum	t	0.3

Table 8. Non-living Ground Cover Characteristics for the *Artemisia nova/Stipa comata* Community

Material	Cover %
Bare ground	11.4
Litter	31.5
Pavement	26.8
Rock	30.3

Artemisia pygmaea Community

This community is located in the southeastern part of the watershed where it occurs as inclusions within the *Chrysothamnus viscidiflorus* var. *puberulus*, *Artemisia nova*, or *Juniperus osteosperma/Artemisia nova* communities.

The annual precipitation for this community is 7.8 inches (rain can 10, Appendix A). Elevation is 5880 feet. Aspect is east. Slope is 1 percent.

Artemisia pygmaea is the dominant species in the community with halogeton *(Halogeton glomeratus)* second in abundance. Indian ricegrass *(Oryzopsis hymenoides)* and squirreltail *(Sitanion hystrix)* contribute little to cover or frequency and are usually found in low vigor. The remaining species in the community are mostly desert shrubs that are very erratic in their occurrence (Table 9).

Pavement accounts for 71.0 percent of the non-living ground cover, bare ground for 23.5 percent, litter for 2.5 percent and rock for 3 percent (Table 10). This community is probably an *Artemisia pygmaea/Oryzopsis hymenoides* habitat-type.

The soil at the macroplot where this vegetation was sampled is a member of a coarse-loamy, mixed, frigid family of Mollic Durorthids (Appendix B-17).

Table 9. Species Cover and Frequency of the *Artemisia pygmaea* Community.

Species	Cover %	20 x 20 Frequency %
Artemisia pygmaea	7.9	88.0
Halogeton glomeratus	t	17.0
Atriplex confertifolia	0.6	7.5
Chrysothamnus viscidiflorus var. *puberulus*	2.7	6.5
Ephedra nevadensis	0.3	1.5
Oryzopsis hymenoides	2.0	4.0
Eriogonum caespitosum	t	7.0
Sphaeralcea coccinea	t	3.0
Astragalus sp.	t	0.5
Sitanion hystrix	t	0.5

Table 10. Non-living Ground Cover Characteristics for the *Artemisia pygmaea* Community

Material	Cover %
Bare ground	23.5
Litter	2.5
Pavement	71.0
Rock	3.0

Big Sagebrush *(Artemisia tridentata)* Communities

1. *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* Community

This community is located in most of the larger drainages and some ravines throughout the watershed. At the higher elevations this community is found in most of the major drainages with either *Pinus monophylla/Juniperus osteosperma*, *J. osteosperma/A. tridentata*, or *J. osteosperma/A. nova* on the ridges. At lower elevations it occurs as alternes with *Eurotia lanata* or as a pure type.

This community receives from 10.4 to 13.7 inches of precipitation per year (rain cans, 14, 15, 16, 17, 19, 20, 21, and 23. Appendix A). Elevation ranges from 6020 to 6400 feet. Aspect is usually south but may be northeast or east. Slope is 2 to 4 percent.

Big sagebrush *(A. tridentata)* dominates the vegetation. It is large and robust in the bottom of the drainages but vigor is lower on the benches. Rabbitbrush *(C. viscidiflorus* var.*puberulus)* is usually a secondary dominant. Low producing forage species such as squirreltail grass *(Sitanion hystrix)* and Sandberg bluegrass *(Poa secunda)* are scarce. Higher producing grasses, such as Indian ricegrass *(Oryzopsis hymenoides)* and needle-and-thread grass *(Stipa comata)* are highly constant but contribute little to frequency or cover and are usually found in low vigor. A variety of invader species such as halogeton *(Halogeton glomeratus)*, tansy-mustard *(Descurainia sophia)* and Russian thistle *(Salsoli kali* var. *tenuifolia)* found scattered throughout the community indicates a deteriorated condition. Winterfat *(Eurotia lanata)*, and spiny hopsage *(Grayia spinosa)* are dispersed in small amounts through the lower elevations of the community. A variety of forbs is found scattered throughout the community, but they contribute little to forage or soil and water holding capacity (Table 11).

The high density of sagebrush accounts for a fair cover of litter. Bare ground and pavement are also fairly high, however, rock cover is rather low (Table 12). This community probably consists of three habitat-types (see page 53).

The soils at the macroplots where this vegetation was sampled are members of a fine-loamy, mixed, frigid family of Entic Mollic Durorthids (Appendix B-15); coarse-loamy, mixed, frigid family of Mollic Calciorthids (Appendix B-16); or fine-loamy, mixed, frigid family of Calcic Argixerolls (Appendix B-25).

Table 11. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* Community

Species	Cover % CL	20/20 Frequency % CL	Constancy %
Artemisia tridentata	12.2 ± 2.9	39.2 ± 7.1	100
Chrysothamnus viscidiflorus var. *puberulus*	2.1 ± 1.9	13.9 ± 6.7	100
Oryzopsis hymenoides	t	13.4 ± 5.8	100
Halogeton glomeratus	t	12.9	60
Sitanion hystrix	t	8.7	100
Sphaeralcea coccina	t	4.0	100
Chenopodium leptophyllum	t	3.4	60
Stipa comata	t	t	100
Eurotia lanata	t	t	80
Grayia spinosa	t	t	60
Astragalus lentiginosus	t	t	40
Descurainia sophia	t	t	40
Chaenactis douglasii	t	t	40
Hilaria jamesii	t	t	40
Opuntia polyacantha	t	t	40
Phlox diffusa	t	t	40
Salsola kali var. *tenuifolia*	t	t	40
Artemisia nova	t	t	20
Astragalus purshii	t	t	20
Crytantha jamesii	t	t	20
Leptodactylon pungens	t	t	20
Poa secunda	t	t	20

Table 12. Non-living Ground Cover Characteristics for the *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* Community

Material	Cover % CL
Bare ground	26.5 ± 21.2
Litter	35.6 ± 8.8
Pavement	32.7 ± 18.6
Rock	5.3

2. *Artemisia tridentata/Stipa comata* Community

This community is located in the large drainages with deep loamy sand soils in the southwest part of the watershed. *A. nova/Stipa comata* is found on the south facing slopes and *A. nova/Agropyron inerme* or *Juniperus osteosperma/A. nova* communities on north facing slopes.

The yearly precipitation for this community is 11.9 inches (rain can 21, Appendix A). Elevation ranges from 6430 to 6520 feet. Aspect is usually northeast but may be north. Slope is 1 to 4 percent.

Under proper management, needle-and-thread grass *(S. comata)* is found as the most abundant species. When severe grazing is allowed, needle-and-thread grass will all but disappear from the community, allowing the big sagebrush (*A. tridentata)* to increase until it completely dominates the community. Grasses such as Sandberg bluegrass *(Poa secunda)*, bluestem wheatgrass *(Agropyron smithii)*, and Indian ricegrass *(Oryzopsis hymenoides)* are highly constant but contribute little to frequency or cover. Invader species such as Russian thistle *(Salsola kali* var. *tenuifolia)* and cheatgrass *(Bromus tectorum)* are present in trace amounts. A variety of forbs are scattered throughout the community but are not constant in occurrence (Table 13). This community is an *Artemisia tridentata/Stipa comata* habitat-type.

Litter accounts for 39.9 percent and bare ground for 40.0 percent of the non-living ground cover. There is a small amount of pavement and very little rock cover (Table 14).

The soil at the macroplots where this vegetation was sampled is a member of a sandy, mixed, frigid family of Typic Torripsamments (Appendix B-1).

Table 13. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Stipa comata* Community

Species	Cover % CL	20/20 Frequency % CL	Constancy %
Stipa comata	4.3 ± 4.9	65.6 ± 66.0	100
Artemisia tridentata	6.9 ± 7.0	24.8 ± 20.0	100
Poa secunda	t	18.9 ± 48.4	100
Chrysothamnus viscidiflorus var. *puberulus*	0.9 ± 1.2	6.8 ± 8.7	100
Agropyron smithii	t	5.1	75
Oryzopsis hymenoides	t	3.8	75
Leptodactylon pungens	t	3.1	75
Machaeranthera canescens	t	t	25
Chaenactis douglasii	t	t	75
Arabis holboellii	t	t	50
Borage sp.	t	t	50
Grayia spinosa	t	t	50
Salsola kali var. *tenuifolia*	t	t	50
Sitanion hystrix	t	t	50
Sphaeralcea coccinea	t	t	50
Astragalus purshii	t	t	25
Astragalus sp.	t	t	25
Bromus tectorum	t	t	25
Chenopodium sp.	t	t	25
Descurainia pinnata	t	t	25
Elymus cinereus	t	t	25
Eriogonum umbellatum	t	t	25
Hilaria jamesii	t	t	25
Lygodesmia spinosa	t	t	25
Oenothera caespitosa	t	t	25
Optunia polyacantha	t	t	25
Phlox longifolia	t	t	25

Table 14. Non-living Ground Cover Characteristics for the *Artemisia tridentata/Stipa comata* Community

Material	Cover % CL
Bare ground	39.9 ± 6.5
Litter	48.0 ± 18.8
Pavement	11.9 ± 2.4
Rock	0.2

Shadscale *(Atriplex confertifolia)* Communities

1. *Atriplex confertifolia* Community

This community is encountered in several parts of the watershed: southwest it alternates with *Eurotia lanata*; northwest at higher elevations it alternates with the *Juniperus osteosperma/Artemisia tridentata* community; and in the northeast it occurs with a large amount of *Chrysothamnus viscidiflorus* var. *puberulus*.

The annual precipitation for this community is 9.4 to 11.0 inches (rain cans 4, 7, 8, and 19, Appendix A). Elevation ranges from 6350 to 6600 feet. Aspect is usually southeast or east but may be south. Slope is 4 to 30 percent.

Halogeton *(Halogeton glomeratus)*, an invader, is the most frequent species in the community and indicates a deteriorated condition. Shadscale *(A. confertifolia)* is the dominant plant. Other shrubs such as winterfat *(Eurotia lanata)*, summer cypress *(Kochia americana)*, and spiny hopsage *(Grayia spinosa)* are erratic in their occurrence and quantity. The most abundant grass is galleta *(Hilaria jamesii)* although other grasses such as squirreltail *(Sitanion hystrix)*, Sandberg bluegrass *(Poa secunda)*, sand dropseed *(Sporobolus cryptandrus)*, and Indian ricegrass *(Oryzopsis hymenoides)* occur in small amounts (Table 15). This community is probably an *Atriplex confertifolia* habitat-type.

Bare ground and pavement account for 60 percent of the non-living ground cover. The remaining 40 percent cover is shared by litter and rock (Table 16).

The soil at the macroplots where this vegetation was sampled is a member of a fine, mixed, frigid family of Typic Haplargids (Appendix B-18).

Table 15. Species Cover, Frequency and Constancy for the *Atriplex confertifolia* Community

Species	Cover %	Frequency%	Constancy %
Halogeton glomeratus	2.3 ± 2.8	40.7 ± 30.2	100
Atriplex confertifolia	9.7 ± 3.4	28.9 ± 7.4	100
Hilaria jamesii	1.1	12.0	60
Kochia americana	0.2	9.6	20
Oryzopsis hymenoides	t	9.1	80
Sphaeralcea coccinea	t	8.4	80
Oenothera clavaeformis	t	6.6	60
Sitanion hystrix	t	6.2	100
Eurotia lanata	t	4.9	60
Chrysothamnus viscidiflorus var. *puberulus*	t	2.2	40
Agropyron spicatum	t	t	40
Echinocactus simpsonii	t	t	40
Poa secunda	t	t	40
Astragalus diphysus	t	t	20
Astragalus lentiginosus	t	t	20
Artemisia tridentata	t	t	20
Erigeron asperuginus	t	t	20
Grayia spinosa	t	t	20
Helianthus annuus	t	t	20
Oenothera caespitosa	t	t	20
Salsola kali var. *tenuifolia*	t	t	20
Sporobolus cryptandrus	t	t	20

Table 16. Non-living Ground Cover Characteristics for the *Atriplex confertifolia* Community

Material	Cover % CL
Bare ground	30.2 ± 3.9
Litter	18.4 ± 11.8
Pavement	29.8 ± 17.1
Rock	21.6

2. *Atriplex confertifolia/Eurotia lanata* Community

This community is located in the west side of the watershed. *Atriplex confertifolia* is found on its north and south, *Artemisia nova* on its west, and on its east *Juniperus osteosperma/A. nova* community.

The annual precipitation of this community is 9.4 inches (rain can 7, Appendix A). Elevation ranges from 6375 to 6400 feet. Aspect is usually west but may be southwest. Slope is 1 to 5 percent.

Shadscale *(A. confertifolia)* and winterfat *(Eurotia lanata)* are co-dominant species. Winterfat, more erratic in its occurrence, expresses higher frequency, but less foliage cover than shadscale. Halogeton *(Halogeton glomeratus)*, highly variable in occurrence, has invaded this community and occurs more frequently than shadscale. Indian ricegrass *(Oryzopsis hymenoides)* and squirreltail grass *(Sitanion hystrix)* are highly constant but contribute little to cover or frequency. Rabbitbrush *(C. viscidiflorus* var. *puberulus)*, bud sagebrush *(Artemisia spinescens)*, horsebrush *(Tetradymia canescens* and *T. glabrata)* are dispersed in small amounts through the community. Also, a variety of forbs appear sporadically (Table 17). This community is probably an *Eurotia lanata/Oryzopsis hymenoides* habitat-type, where heavy grazing has reduced *Eurotia lanata* and allowed *Atriplex confertifolia* to invade and increase to its present state.

Litter is fairly high accounting for 35.2 percent of the non-living ground cover. Pavement accounts for 29.2 percent, bare ground for 31.2 percent, and rock for only 4.4 percent (Table 18).

The soil at the macroplots where this vegetation was sampled is a member of a fine-loamy, mixed, frigid family of Duric Camborthids (Appendix B-9).

Table 17. Species Cover, Frequency and Constancy for the *Atriplex confertifolia/Eurotia lanata* Community

Species	Cover %	20/20 Frequency %	Constancy %
Eurotia lanata	4.2	39.7	100
Halogeton glomeratus	t	23.2	100
Atriplex confertifolia	4.4	21.0	100
Sphaeralcea coccinea	t	14.5	100
Oryzopsis hymenoides	t	8.2	100
Chrysothamnus viscidiflorus var. *puberulus*	t	8.0	67
Sitanion hystrix	t	7.8	100
Collinsia parviflora	t	3.3	33
Artemisia spinescens	t	3.2	67
Tetradymia spinosa	t	t	100
Astragalus purshii	t	t	67
Astragalus atratus	t	t	33
Descurainia sophia	t	t	33
Tetradymia glabrata	t	t	33

Table 18. Non-living Ground Cover Characteristics for the *Artemisia confertifolia/Eurotia lanata* Community

Material	Cover %
Bare ground	31.2
Litter	35.2
Pavement	29.2
Rock	4.4

Rabbitbrush *(Chrysothamnus viscidiflorus* var. *puberulus)* Community

This community is encountered in the southeast part of the watershed where it occurs with inclusions of *Artemisia nova* and *Artemisia pygmaea*.

The annual precipitation for this community is 7.8 to 10.1 inches (rain cans 9, 10, 11, and 22. Appendix A). Elevation ranges from 5850 to 6100 feet. Aspect is either east or northeast. Slope is 2 to 3 percent.

The community is dominated by rabbitbrush *(C. viscidiflorus* var. *puberulus)* with halogeton *(H. glomeratus)* second in abundance. Indian ricegrass *(Oryzopsis hymenoides)* is highly constant but contributes little to cover or frequency and is usually found in low vigor. Galleta grass *(Hilaria jamesii)* is erratic in its occurrence, and contributes little to cover or frequency. The remaining species are mostly shrubs such as *Atriplex confertifolia, A. canescens, Artemisia spinescens, Kochia americana, Grayia spinosa, Ephedra nevadensis, Artemisia nova* and *Eurotia lanata* found in varied amounts throughout the community (Table 19).

This is a low seral community which occurs on the same soil and adjacent to the *A. nova* community indicating that the pristine vegetation was an *A. nova* habitat-type. The community has probably been subjected to very hard use by sheep causing *A. nova* and other palatable species to decrease, thus allowing *C. viscidiflorus* var. *puberulus* to increase to its present state. This community is probably an *Artemisia nova/ Oryzopsis hymenoides* habitat-type.

Pavement accounts for 56.1 percent of the non-living ground cover, bare ground for 16.8 percent, litter for 18.2 percent and rock for 8.8 percent (Table 20).

The soil at the macroplots where this vegetation was sampled is a member of a coarse-loamy, mixed, frigid family of Mollic Durorthids (Appendix B-17).

Table 19. Species Cover, Frequency and Constancy for the *Chrysothamnus viscidiflorus* var. *puberulus* Community

Species	Cover % CL	Frequency % CL	Constancy %
Chrysothamnus viscidiflorus puberulus	8.8 ± 6.3	40.7 ± 24.6	100
Halogeton glomeratus	3.1	34.2 ± 32.1	100
Atriplex confertifolia	1.6	8.6	83
Hilaria jamesii	0.5	11.7	66
Sphaeralcea coccinea	t	17.9	100
Oryzopsis hymenoides	t	3.4	100
Artemisia spinescens	t	8.8	66
Kochia americana	t	5.5	50
Salsola kali var. *tenuifolia*	t	t	66
Ephedra nevadensis	t	t	50
Grayia spinosa	t	t	50
Astragalus diphysus	t	t	33
Eurotia lanata	t	t	33
Sitanion hystrix	t	t	33
Artemisia nova	t	t	16
Artemisia tridentata	t	t	16
Atriplex canescens	t	t	16

Table 20. Non-living Ground Cover Characteristics for the *Chrysothamnus viscidiflorus* var. *puberulus* Community.

Material	Cover % CL
Bare ground	16.8 ± 10.1
Litter	18.2 ± 8.2
Pavement	56.1 ± 16.8
Rock	8.8 ± 6.3

Winterfat *(Eurotia lanata)* Dominated Communities

1. *Eurotia lanata* Community

This community occurs as a pure type in the main drainage in the eastern part of the watershed, and in smaller scattered drainages in the northwest and southeast sections of the watershed. It also alternates with *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus*, *Atriplex confertifolia*, and *Artemisia nova* communities in various parts of the watershed.

The annual precipitation for this community is 7.8 to 10.8 inches (rain cans 10, 11, 12, 13, 14, 19 and 20, Appendix A). Elevation ranges from 5800 to 6100 feet. Aspect is usually south or southeast but may be southwest. Slope is 1 to 2 percent.

This community has been severely abused by sheep. Halogeton *(Halogeton glomeratus)* is found in great abundance with smaller amounts of Russian thistle *(Salsola kali* var. *tenuifolia)*. Winterfat *(E. lanata)* is usually encountered in fair amounts but in low vigor. In some heavily used areas winterfat has almost disappeared from the community. Indian ricegrass *(Oryzopsis hymenoides)* is highly constant but contributes little to cover or frequency. A variety of grasses and forbs are scattered throughout the community (Table 21). This community is probably an *Eurotia lanata/Oryzopsis hymenoides* habitat-type.

Bare ground accounts for 77.2 percent of the non-living ground cover, litter for 19.8 percent, and pavement and rock for 3.0 percent (Table 22).

The soils at the macroplots where this vegetation was sampled is a member of a coarse-loamy, mixed, frigid family of Typic Torriorthents (Appendix B-2).

Table 21. Species Cover, Frequency and Constancy for the *Eurotia lanata* Community

Species	Cover % CL	Frequency % CL	Constancy %
Halogeton glomeratus	20.3 ± 12.2	83.5 ± 14.0	100
Eurotia lanata	8.1 ± 2.4	61.4 ± 18.4	100
Salsola kali var. *tenuifolia*	t	24.1	60
Chenopodium leptophyllum	t	5.1	80
Oryzopsis hymenoides	t	2.2	100
Sphaeralcea coccinea	t	2.2	20
Sitanion hystrix	t	t	40
Eriophyllum pringlei	t	t	20
Hilaria jamesii	t	t	20
Opuntia polycantha	t	t	20

Table 22. Non-living Ground Cover Characteristics for the *Eurotia lanata* Community.

Material	Cover % CL
Bare ground	77.2 ± 7.4
Litter	19.8 ± 5.4
Pavement	2.8
Rock	0.2

2. *Descurainia sophia* Community

This community is located in "beat out" *Eurotia lanata* areas throughout the watershed. It covers small areas and is of relatively minor importance.

The annual precipitation of this community is around 10.8 inches (rain can 20. Appendix A). Elevation is 6300 feet. Aspect is east. Slope is 2 percent.

This area before abuse was a winterfat *(Eurotia lanata)* community. Now it has been invaded by annual vegetation such as tansy mustard *(D. sophia)*, halogeton *(Halogeton glomeratus)*, lambsquarters goosefoot *(Chenopodium album)* and *(Chenopodium leptophyllum)* in a large quantity. Winterfat is fairly frequent but in very low vigor. Indian ricegrass *(Oryzopsis hymenoides)* and galleta grass (*Hilaria jamesii*) are found only in trace amounts (Table 23). This community is probably an *Eurotia lanata/Oryzopsis hymenoides* habitat-type.

The soil at the macroplots where this vegetation was sampled is a member of a coarse-loamy, mixed, frigid family of the Typic Torriorthents (Appendix B-2).

Table 23. Species Cover and Frequency for the *Descurainia sophia* Community.

Species	Cover %	20/20 Frequency %
Descurainia sophia	2.1	67.0
Halogeton glomeratus	24.8	71.5
Chenopodium album	t	65.0
Eurotia lanata	t	51.0
Chenopodium leptophyllum	t	22.5
Hilaria jamesii	t	2.0
Oryzopsis hymenoides	t	0.5
Salsola kali var. *tenuifolia*	t	0.5

Table 24. Non-living Ground Cover Characteristics for the *Descurainia sophia* Community.

Material	Cover %
Bare ground	64.0
Litter	34.0
Pavement	1.0
Rock	1.0

Spiny Hopsage-Bud Sagebrush
(Grayia spinosa/Artemisia spinescens)
Community.

This community is located at the bottom of the watershed in a large wash running southeast. At the upper part of the wash *Artemisia spinescens* thins out and *Artemisia tridentata* is more abundant. Out of the wash *Artemisia nova* or *Artemisia nova/Atriplex confertifolia* communities are encountered.

The annual precipitation for this community is 8.4 inches (rain can 9, Appendix A). Elevation ranges from 5800 to 5830 feet. Aspect is east. Slope is 1 to 2 percent.

Russian thistle (*Salsola kali* var. *tenuifolia*) an invader, is the most frequent species in the community, and indicates a deteriorated condition. Spiny hopsage *(G. spinosa)* dominates the vegetation with bud sagebrush (*A. spinescens)* a secondary dominant. Shrubs such as *Atriplex nuttallii*, shadscale *(Atriplex confertifolia)* and grasses, Indian ricegrass *(Oryzopsis hymenoides)*, galleta grass (*Hilaria jamesii)* and squirreltail *(Sitanion hystrix)* are found only in trace amounts (Table 25). This community is probably a *Grayia spinosa/Artemisia spinescens* habitat-type.

Pavement accounts for almost half of the non-living ground cover, litter for 29.5 percent, bare ground for 19.0 percent, and rock for 4.5 percent (Table 26).

The soil at the macroplots where this vegetation was sampled is a member of a coarse-loamy, mixed, frigid family of Typic Camborthids (Appendix B-7).

Table 25. Species Cover and Frequency for the *Grayia spinosa/Artemisia spinescens* Community

Species	Cover %	20/20 Frequency %
Grayia spinosa	9.9	19.5
Salsola kali var. *tenuifolia*	4.4	67.0
Artemisia spinescens	t	25.2
Oryzopsis hymenoides	t	3.2
Halogeton glomeratus	t	3.2
Atriplex nuttallii	t	2.8
Chenopodium leptophylum	t	2.0
Sphaeralcea coccinea	t	1.0
Hilaria jamesii	t	0.8
Eriophyllum pringlei	t	0.5
Atriplex confertifolia	t	0.2
Sitanion hystrix	t	0.2

Table 26. Non-living Ground Cover Characteristics for the *Grayia spinosa/Artemisia spinescens* Community.

Material	Cover %
Bare ground	19.0
Litter	29.5
Pavement	47.0
Rock	4.5

Juniper *(Juniperus osteosperma)* Communities

1. *Juniperus osteosperma* Community

This community is encountered in various parts of the watershed where the juniper forms a closed community.

The annual precipitation for this community is 10.5 to 10.8 inches (rain cans 20 and 24, Appendix A). Elevation ranges from 6300 to 6500 feet. Aspect is usually southeast but may be east. Slope is 5 to 7 percent.

Juniper *(Juniperus osteosperma)* dominates the community with halogeton *(Halogeton glomeratus)* the most abundant species in the understory. Shrubs such as rabbitbrush *(Chrysothamnus viscidiflorus* var. *puberulus)*, black sagebrush *(Artemisia nova)* and big sagebrush *(Artemisia tridentata)* are found in small amounts throughout the community. Galleta grass *(Hilaria jamesii)*, Indian ricegrass *(Oryzopsis hymenoides)*, squirreltail *(Sitanion hystrix)*, and *Stipa pinetorum* vary in their occurrence and amount, and they contribute very little to cover or frequency. A variety of forbs occur erratically throughout the community (Table 27). This community is probably a *Juniperus osteosperma* habitat-type.

Bare ground accounts for 33.3 percent of the non-living ground cover, pavement for 27.2 percent, litter for 22.0 percent and rock for 17.5 percent (Table 27).

The soil at the macroplot where this vegetation was sampled is a member of a fine-loamy, mixed, frigid family of Entic Mollic Durorthids (Appendix B-15).

Table 27. Species Cover, Frequency and Constancy for the *Juniperus osteosperma* Community

Species	Cover %	Frequency %	Constancy %
Juniperus osteosperma	17.9	-	100
Halogeton glomeratus	t	39.7	66
Chrysothamnus viscidiflorus var. *puberulus*	t	11.7	100
Oryzopsis hymenoides	t	7.8	100
Stipa pinetorum	t	6.9	66
Descurainia sophia	t	5.7	66
Artemisia nova	t	5.2	66
Hilaria jamesii	t	4.7	66
Artemisia tridentata	t	3.5	66
Astragalus diphysus	t	2.2	66
Euphorbia serpyllifolia	t	3.2	66
Oenthera clavalformis	t	2.0	33
Cryptantha jamesii	t	1.8	100
Astragalus purshii	t	1.5	66
Phlox diffusa	t	1.2	33
Caulanthus crassicaulus	t	2.0	100
Atriplex nuttallii	t	t	33
Chaenactis douglasii	t	t	33
Elymus cinereus	t	t	33
Ephedra viridis	t	t	33
Eriogonum heermannii	t	t	33
Eurotia lanata	t	t	33
Ipomopsis aggregate	t	t	33
Opuntia polyacantha	t	t	33
Salsola kali var. *tenuifolia*	t	t	33
Sitanion hystrix	t	t	33
Sphaeralcea coccinea	t	t	33

Table 28. Non-living Ground Cover Characteristics for the *Juniperus osteosperma* Community

Material	Cover %
Bare ground	33.3
Litter	22.0
Pavement	27.2
Rock	17.5

2. *Juniperus osteosperma/Artemisia nova* Community

This is the largest community found in the watershed. It is usually encountered at the higher elevations with *Artemisia nova* occupying the juniper-free ridges and *Artemisia tridentata* in the larger drainages.

The annual precipitation for this community is 9.3 to 11.9 inches (rain cans 2, 5, 8, 21, and 24. Appendix A). Elevation ranges from 6000 to 6300 feet. Aspect is usually north or northeast but may be east or southeast. Slope is 3 to 22 percent.

Juniper *(Juniperus osteosperma)* cover is fairly low with black sagebrush *(Artemisia nova)* dominant in the understory. Halogeton *(Halogeton glomeratus)* and Russian thistle *(Salsola kali* var. *tenuifolia)* both invader species, are found highly constant and occur more or almost as frequently as black sagebrush. Shrubs such as rabbitbrush *(Chrysothamnus viscidiflorus* var. *puberulus)*, pigmy sage *(Artemisia pygmaea)*, and winterfat *(Eurotia lanata)* are fairly constant but contribute little to frequency or cover. Galleta grass *(Hilaria jamesii)*, Indian ricegrass *(Oryzopsis hymenoides)*, Sandberg bluegrass (*Poa secunda)*and needle-and-threadgrass *(Stipa comata)* are found in small quantities and vary as to frequency and constancy. A variety of forbs are found in trace amounts scattered through the community (Table 29). This community is probably a *Juniperus osteosperma/Artemisia nova/Oryzopsis hymenoides* habitat-type.

Pavement accounts for 39.6 percent of the non-living ground cover, litter for 26.8 percent, bare ground for 21.8 percent, and rock for 11.8 percent (Table 30).

The soils at the macroplots where this vegetation was sampled are members of a fine-loamy, mixed, frigid family of Mollic Camborthids (Appendix B-11); fine-loamy, mixed, frigid family of Mollic Durargids (Appendix B-24); or coarse-loamy, mixed, frigid family of Entic Mollic Durorthids (Appendix B-16).

Table 29. Species Cover, Frequency and Constancy for the *Juniperus osteosperma/Artemisia nova* Community

Species	Cover % CL	20/20 Frequency % CL	Constancy%
Juniperus osteosperma	5.7	-	83
Halogeton glomeratus	1.1	26.9	100
Artemisia nova	5.2 ± 1.5	21.9 ± 10.2	100
Salsola kali var. *tenuifolia*	t	18.5 ± 18.4	100
Chrysothamnus viscidiflorus var. *puberulus*	t	10.7	83
Artemisia pygmaea	t	7.9	67
Ephedra nevadensis	t	7.3	67
Oryzopsis hymenoides	t	6.2	100
Hilaria jamesii	t	3.1	33
Atriplex confertifolia	t	2.2	50
Sphaeralcea coccinea	t	2.0	67
Eurotia lanata	t	t	83
Ephedra viridis	t	t	67
Poa secunda	t	t	67
Sitanion hystrix	t	t	67
Cryptantha jamesii	t	t	50
Caulanthus crassicaulis	t	t	33
Chenopodium leptophylum	t	t	33
Ipomopsis aggregate	t	t	33
Lygodesmia spinosa	t	t	33
Stipa comata	t	t	33
Astragalus purshii	t	t	17
Bromus tectorum	t	t	17
Grayia spinosa	t	t	17
Gutierrezia sarothrae	t	t	17

Table 30. Non-living Ground Cover Characteristics for the *Juniperus osteosperma/Artemisia nova* Community

Material	Cover % CL
Bare ground	21.8 ± 17.7
Litter	26.8 ± 6.6
Pavement	39.6 ± 18.1
Rock	11.8

2. *Juniperus osteosperma/Artemisia tridentata* Community

This community is located at higher elevations in the northeast part of the watershed. It is usually encountered with *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* in the drainages but it may also occur with *Eurotia lanata* or *Atriplex confertifolia* communities in the drainages.

The annual precipitation for this community is 9.4 to 11.2 inches (rain cans 5, 7, 18. Appendix A). Elevation ranges from 6500 to 6700 feet. Aspect is usually east or southeast but it may be west. Slope is 4 to 12 percent.

Juniper *(Juniperus osteosperma)* cover is around 8 percent while big sagebrush *(A. tridentata)* dominates the understory vegetation. Rabbitbrush *(C. viscidiflorus* var. *puberulus)* is highly constant but contributes little to cover or frequency. Other shrubs such as spiny hopsage *(Grayia spinosa)*, shadscale (*A. confertifolia)* and Mormon tea *(Ephedra nevadensis)* occur only in trace amounts. Indian ricegrass *(Oryzopsis hymenoides)* is highly constant but contributes little to cover or frequency. Squirreltail *(Sitanion hystrix)*, galleta grass *(Hilaria jamesii)*, *Stipa pinetorum* and Great Basin wildrye *(Elymus cinereus)* are found in small amounts and are erratic in occurrence. A variety of forbs, varied in amount, are found scattered throughout the community (Table 31). This community is probably a *Juniperus osteosperma/Artemisia tridentata/Oryzopsis hymenoides* habitat-type.

Bare ground accounts for 40.1 percent of the non-living ground cover, litter for 34.0 percent, pavement for 18.6 percent and rock for 7.5 percent (Table 32).

The soils at the macroplots where this vegetation was sampled are members of a clayey-skeletal, mixed, frigid, shallow family of Mollic Camborthids (Appendix B-12) or coarse-loamy, mixed, frigid, shallow family of Duric Mollic Camborthids (Appendix B-10).

Table 31. Species Cover, Frequency and Constancy for the *Juniperus osteosperma/Artemisia tridentata* Community

Species	Cover % CL	Frequency % CL	Constancy %
Juniperus osteosperma	8.0	-	-
Artemisia tridentata	7.4 ± 3.5	20.2 ± 3.5	100
Chrysothamnus viscidiflorus var. *puberulus*	1.6 t	16.9 ± 9.9	100
Astragalus diphysus	t	13.5	100
Descurainia sophia	t	6.1	100
Oryzopsis hymenoides	t	4.7	100
Sitanion hystrix	t	3.8	80
Sphaeralcea coccinea	t	2.0	80
Grayia spinosa	t	t	80
Artemisia nova	t	t	60
Atriplex confertifolia	t	t	60
Caulanthus crassicaulis	t	t	40
Chaenactis douglasii	t	t	40
Cryptantha jamesii	t	t	40
Ephedra nevadensis	t	t	40
Hilaria jamesii	t	t	40
Chenopodium album	t	t	20
Elymus cinereus	t	t	20
Euphorbia serphyllifolia	t	t	20
Halogeton glomeratus	t	t	20
Phlox diffusa	t	t	20
Stipa pinetorum	t	t	20

Table 32. Non-living Ground Cover Characteristics for the *Juniperus osteosperma/Artemisia tridentata* Community

Material	Cover % CL
Bare ground	40.1 ± 6.5
Litter	34.0 ± 7.0
Pavement	18.6 ± 3.7
Rock	7.5

4. *Juniperus osteosperma/Artemisia nova/ Atriplex confertifolia* Community

This community is encountered in the northeast part of the watershed. It has inclusions of *Artemisia nova/Atriplex confertifolia* on the ridges and *Juniperus osteosperma/Artemisia nova* is found on the east and south, with *Atriplex confertifolia* on the west, and with *A. nova* and *Eurotia lanata* alternes on the north. Apparently this is a transition community but broad enough to study separately. A large variety of shrubs and forbs in the understory lends support to this supposition.

The annual precipitation of this community is 11.0 to 11.6 inches (rain cans 1, 3 and 4, Appendix A). Elevation ranges from 6100 to 6600 feet. Aspect is usually west or southwest but may be east. Slope is 2 to 18 percent.

Juniper *(J. osteosperma)* cover is fairly low with black sagebrush *(A. nova)* and shadscale *(A. confertifolia)* sharing dominance in the understory. Other shrubs like rabbitbrush *(Chrysothamnus viscidiflorus* var. *puberulus)*, Mormon tea *(Ephedra nevadensis)*, snakeweed *(Gutierrezia sarothrae)*, horsebrush *(Tetradymia glabrata)*, spiny hopsage *(Grayia spinosa)*, and winterfat *(Eurotia lanata)* are found in small quantities and usually vary in occurrence (Table 33). This community on the loamy-skeletal, mixed, frigid,shallow family of the Mollic Camborthids is probably a *J. osteosperma/A. nova/Oryzopsis hymenoides* habitat-type.

Pavement accounts for 37.4 percent of the non-living ground cover, litter for 35.8 percent, rock for 15.0 percent and bare ground for 13.8 percent (Table 34).

The soils at the macroplots where this vegetation was sampled are members of a loamy-skeletal, mixed, frigid, shallow family of Mollic Camborthids (Appendix B-13) or fine-loamy, mixed, frigid family of Typic Camborthids (Appendix B-8).

Table 33. Species, Cover, Frequency and Constancy for the *Juniperus osteosperma/Artemisia nova/Atriplex confertifolia* Community.

Species	Cover % CL	Frequency % 20/20 CL	Constancy %
Juniperus osteosperma	5.6	-	-
Artemisia nova	5.8 ± 1.5	23.6 ± 9.2	100
Atriplex confertifolia	3.5 ± 4.2	20.6 ± 7.4	100
Halogeton glomeratus	t	12.1	60
Oryzopsis hymenoides	t	8.8	100
Chrysothamnus viscidiflorus var. *puberulus*	0.8	8.7	80
Sphaeralcea coccinea	t	7.9	60
Gutierrezia sarothrae	t	6.1	20
Sitanion hystrix	t	5.2	100
Descurainia sophia	t	2.9	20
Ephedra nevadensis	t	t	60
Collinsia parviflora	t	t	40
Penstemon kingii	t	t	40
Poa secunda	t	t	40
Salsola kali var. *tenuifolia*	t	t	40
Stipa pinetorum	t	t	40
Symphoricarpos fragrans	t	t	40
Tetradymia glabrata	t	t	40
Aster Sp.	t	t	20
Astragalus purshii	t	t	20
Astragalus sp.	t	t	20
Chenopodium leptophyllum	t	t	20
Cryptantha jamesii	t	t	20
Euphorbia serphyllifolia	t	t	20
Eurotia lanata	t	t	20
Grayia spinosa	t	t	20
Oenothera calvacfermis	t	t	20
Pedicularis centranthera	t	t	20
Phacelia sp.	t	t	20
Phlox diffusa	t	t	20
Stipa comata	t	t	20

Table 34. Non-living Ground Cover Characteristics for the *Juniperus osteosperma/Artemisia nova/Atriplex confertifolia* Community

Material	Cover %
Bare ground	13.8 ± 11.3
Litter	35.8 ± 18.5
Pavement	37.4 ± 15.8
Rock	15.0 ± 17.6

5. *Juniperus osteosperma/Artemisia nova*/rock Community

This community is distinguished from the previous *Juniperus osteosperma/Artemisia nova* community by its physiographic placement. It is located on the steep, rocky ridges usually found associated with the *J. osteosperma/Cercocarpus intricatus*. This community is encountered on the northeast rim, the east rim and scattered through the center of the watershed.

The annual precipitation for this community is 10.5 to 11.9 inches (rain cans 2 and 24, Appendix A). Elevation ranges from 6300 to 6400 feet. Aspect is usually east but may be west. Slope is 30 to 50 percent with inclusion of 15 to 30 percent slopes along the ridge.

There is a sparse cover of juniper *(J. osteosperma)* with black sagebrush *(A. nova)* dominant in the understory. Shrubs such as shadscale *(Atriplex confertifolia)*, winterfat *(Eurotia lanata)*, Mormon tea *(Ephedra viridis* and *E. nevadensis)*, snakeweed *(Gutierrezia sarothrae)* and rabbitbrush *(Chrysothamnus viscidiflorus* var.*puberulus)* are present but sporadic in occurrence. Indian ricegrass *(Oryzopsis hymenoides)*, Sandberg bluegrass *(Poa secunda)* and squirreltail *(Sitanion hystrix)* are highly constant but contribute little to cover or frequency. Galleta grass *(Hilaria jamesii)*, awnless bluebunch wheatgrass *(Agropyron inerme)*, and needle-and-thread grass *(Stipa comata)* are found only in trace amounts. A large variety of forbs are encountered in the community. Halogeton *(Halogeton glomeratus)* and Russian thistle *(Salsola kali* var. *tenuifolia)* are present in sparse amounts. Borage *(Cryptantha jamesii)* and desert mallow *(Sphaeralcea coccinea)* are highly constant but appear only in small quantities (Table 35). This community is probably a *Juniperus osteosperma/Artemisia nova*/rock habitat-type.

Rock and pavement account for 79.3 percent of the non-living ground cover, litter for 16.7 percent and bare ground for 4.0 percent (Table 36).

The soil at the macroplots where this vegetation was sampled is a member of a loamy-skeletal, mixed, frigid family of Lithic Torriorthents (Appendix B-3).

Table 35. Species Cover, Frequency and Constancy for the *Juniperus osteosperma/Artemisia nova*/Rock Community

Species	Cover % CL	20/20 Frequency % CL	Constancy %
Juniperus osteosperma	2.1	-	-
Artemisia nova	6.6 ± 2.9	36.3 ± 16.1	100
Salsola kali var. *tenuifolia*	t	14.9	60
Oryzopsis hymenoides	t	14.5 ± 21.3	100
Poa secunda	t	11.5 ± 17.6	100
Atriplex confertifolia	t	6.8 ± 5.7	100
Sphaeralcea coccinea	t	5.4	100
Hilaria jamesii	t	4.5	20
Halogeton glomeratus	t	4.2	100
Sitanion hystrix	t	2.9	100
Chrysothamnus viscidiflorus var. *puberulus*	t	2.7	80
Stipa comata	t	2.3	20
Ephedra viridis	t	2.0	60
Cryptantha jamesii	t	t	100
Agropyron inerme	t	t	60
Astragalus purshii	t	t	60
Haplopappus acaulis	t	t	60
Phlox diffusa	t	t	60
Arenaria kingii	t	t	40
Caulanthus crassicaulis	t	t	40
Eurotia lanata	t	t	40
Chenopodium leptophylum	t	t	20
Echinocactus simpsonii	t	t	20
Ephedra nevadensis	t	t	20
Erigeron annuus	t	t	20
Eriogonum heermanni	t	t	20
Gutierrezia sarothrae	t	t	20
Oenthera caespitosa	t	t	20
Stipa pinetorum	t	t	20

Table 36. Non-living Ground Cover Characteristics for the *Juniperus osteosperma/Artemisia nova*/Rock Community

Material	Cover % CL
Bare ground	4.0 ± 2.6
Litter	16.7 ± 13.2
Pavement	44.4 ± 19.1
Rock	34.9 ± 20.7

6. *Juniperus osteosperma/Agropyron inerme* Community

This community is located on the steeper ridges in the center of the watershed. *Juniperus osteosperma/Artemisia nova* is usually encountered in all directions, however, *Artemisia nova/Agropyron inerme* may be found at higher elevations.

The annual precipitation for the community is 10.5 inches (rain can 24, Appendix A). Elevation is 6200 feet. Aspect is east. Slope is 22 percent.

Juniper *(J. osteosperma)* provides a fairly good cover with awnless bluebunch wheatgrass (*Agropyron inerme)* the dominant understory species. Indian ricegrass *(Oryzopsis hymenoides)* and needle-and-threadgrass *(Stipa comata)* are found in small quantities. Black sagebrush *(A. nova)* and other shrubs are found in trace amounts. Also a variety of forbs are encountered but only *Eriogonum heermenii* occurs frequently enough to mention (Table 37). This community is probably a *Juniperus osteosperma/Agropyron inerme* habitat-type.

Pavement accounts for 53 percent of the non-living ground cover, rock for 18 percent, bare ground for 17 percent, and litter for 13 percent (Table 38).

The soil at the macroplots where this vegetation was sampled is a member of a loamy-skeletal, carbonatic, frigid family of Lithic Mollic Calciorthids (Appendic B-5).

Table 37. Species Cover and Frequency for the *Juniperus osteosperma/Agropyron inerme* Community

Species	Cover %	20/20 Frequency %
Juniperus osteosperma	9.9	-
Agropyron inerme	4.8	39.5
Erogonum heermennii	t	13.0
Phlox diffusa	t	5.0
Oryzopsis hymenoides	t	4.5
Arenaria kingii	t	3.5
Haplapappus aculis	t	3.0
Artemisia nova	t	2.5
Ephedra nevadensis	t	2.0
Cryptantha jamesii	t	1.5
Astragalus purshii	t	0.5
Chrysothamnus viscidiflorus	t	0.5
Ipomapsis aggregate	t	0.5
Stipa comata	t	0.5

Table 38. Non-living Ground Cover Characteristics for the *Juniperus osteosperma/Agropyron inerme* Community

Material	Cover %
Bare ground	17.0
Litter	13.0
Pavement	52.0
Rock	18.0

7. *Juniperus osteosperma/Carcocarpus intricatus* Community

This community, in most cases, occurs in the same general locations as *Juniperus osteosperma/Artemisia nova*/rock. It is encountered on the steep rocky ridges on the northeastern rim, the east rim, and scattered through the center of the watershed.

The annual precipitation for this community is 10.5 to 11.9 inches (rain cans 2 and 24, Appendix A). Elevation ranges from 6200 to 6500 feet. Aspect is usually north or west but may be east. Slope is 30 to 50 percent with inclusions of 15 to 30 percent slopes along the ridge.

The juniper trees are sparse in a very open stand. Much of the space between the trees is occupied by *Cercocarpus intricatus*, *Symphoricarpos fragrans* and *Chrysothamnus greenii*. Other shrubs such as black sagebrush *(A. nova)* shadscale *(Atriplex confertifolia)* and Mormon tea *(Ephedra viridis)* occur sporadically. Indian ricegrass *(Oryzopsis hymenoides)*, *Stipa pinetorium*, Sandberg bluegrass *(Poa secunda)* and squirreltail *(Sitanion hystrix)* are highly constant but contribute little to frequency or cover. A large variety of forbs is encountered but *Haplopoppus acaulis* is the most frequent species in the community (Table 39). This community is probably a *Juniperus osteosperma/Cercocarpus intricatus* habitat-type.

Rock and pavement accounts for 85.3 percent of the non-living ground cover, litter about 11.7 percent, and bare ground for 3.0 percent (Table 40).

The soil at the macroplots where this vegetation was sampled is a member of a loamy-skeletal, mixed, frigid family of Lithic Torriorthents (Appendix B-3).

Table 39. Species Cover, Frequency and Constancy for the *Juniperus osteosperma/Cercocarpus intricatus* Community

Species	Cover % CL	Frequency % CL	Constancy %
Juniperus osteosperma	1.5	-	-
Haplopappus acaulis	1.1	24.0	100
Poa secunda	t	18.1	100
Halogeton glomeratus	t	14.0	60
Artemisia nova	t	11.4	80
Phlox diffusa	t	11.0	100
Salsola kali var.*tenuifolia*	t	9.7	80
Cryptantha jamesii	t	9.3	100
Stipa pinetorium	t	9.1	80
Oryzopsis hymenoides	t	8.1 ± 3.9	100
Artemisia pygmaea	t	7.7	20
Cercocarpus intricatus	5.2 ±2.4	5.0 ± 3.2	100
Arenaria kingii	t	4.4	60
Chrysothamnus greenii	t	4.0	60
Sitanion hystrix	t	3.6	100
Eriogonum andinum	t	2.5	60
Atriplex confertifolia	t	2.5	80
Symphoricarpos fragrans	t	2.3	100
Erigeron asperuginas	t	2.0	60
Sphaeralcea coccinea	t	t	60
Ephedra viridis	t	t	40
Gutierrezia sarothrae	t	t	40
Hilaria jamesii	t	t	40
Agropyron inerme	t	t	20
Astragalus purshii	t	t	20
Cheanactis douglasii	t	t	20
Crepis acuminata	t	t	20
Echinocactus simpsonii	t	t	20
Eriogonum heracleoides	t	t	20
Ipomopsis aggregate	t	t	20
Stipa comata	t	t	20

Table 40. Non-living Ground Cover Characteristics for the *Juniperus osteosperma/Cercocarpus intricatus* Community

Material	Cover % CL
Bare ground	3.0
Litter	11.7 ± 6.8
Pavement	47.9 ± 20.6
Rock	37.4 ± 14.2

Pinyon-Juniper (*Pinus monophylla/Juniperus osteosperma* Communities

1. *Pinus monophylla/Juniperus osteosperma* Community.

This community is located in the northern most part of the watershed. *Artemisia tridentata/Chrysothamnus viscidiflorus* var.*puberulus* is found in the larger drainage and as elevation decreases *Juniperus osteosperma/Artemisia tridentata* is found.

The annual precipitation for this community is 12.0 to 13.7 inches (rain cans 15 and 16, Appendix A). Elevation ranges from 6850 to 7000 feet. Aspect is usually east but may be southeast or northeast. Slope is 3 to 30 percent.

The stand of trees is rather closed, as reflected in the high cover of pinyon-juniper and the low frequency of a wide variety of species. Bitterbrush *(Purshia tridentata)*, big sagebrush *(A.tridentata)* amd rabbitbrush *(C. viscidiflorus* var. *puberulus)* are highly constant but occur in small sporadic amounts, along with small erratic quantities of squirreltail *(Sitanion hystrix)*, Thurber's needlegrass *(Stipa thurberiana)*, Great Basin wildrye *(Elymus cinereus)*, Indian ricegrass *(Oryzopsis hymenoides)*, Sandberg bluegrass *(Poa secunda)*, and needle-and-threadgrass *(Stipa comata)*. A large variety of forbs are also scattered throughout the community (Table 41). This community is probably a *Pinus monophylla/Juniperus osteosperma* habitat-type.

Litter accounts for 38.0 percent of the non-living ground cover, bare ground for 25.2 percent, pavement for 19.0 percent and rock for 17.8 percent (Table 42).

The soils at the macroplots where this vegetation was sampled are members of a fine, mixed, frigid family of Mollic Durargids (Appendix B-23) or fine-loamy, mixed, frigid family of Haplic Mollic Durargids (Appendix B-22).

Table 41. Species Cover, Frequency and Constancy for the *Pinus monophylla/Juniperus osteosperma* Community

Species	Cover %	Frequency % CL	Constancy %
Juniperus osteosperma	13.8	-	100
Pinus monophylla	13.0	-	100
Sitanion hystrix	t	11.7 ± 12.3	100
Astragalus sp.	t	11.3 ± 8.6	100
Erigeron annuus	t	9.7	80
Chrysothamnus viscidiflorus var. *puberulus*	t	8.4	100
Artemisia tridentata	t	5.3	80
Poa secunda	t	5.0	80
Purshia tridentata	t	3.6 ± 3.1	100
Stipa thurberiana	t	2.8	80
Oryzopsis hymenoides	t	2.0	60
Cryptantha jamesii	t	t	20
Astragalus deflexum	t	t	60
Astragalus purshii	t	t	60
Bromus tectorum	t	t	60
Chaenacti s douglasii	t	t	60
Opuntia polyacantha	t	t	60
Astragalus hornii	t	t	40
Caulanthus crassicaulis	t	t	40
Crepis occidentalis	t	t	40
Elymus cinereus	t	t	40
Leptodactylon pungens	t	t	40
Arenaria kingii	t	t	20
Chrysothamnus nauseosus	t	t	20
Chrysothamnus viscidiflorus	t	t	20
Descurainia sophia	t	t	20
Eriogonum deflexum	t	t	20
Lupinus caudatus	t	t	20
Phlox longifolia	t	t	20
Sphaeralcea coccinea	t	t	20
Stipa comata	t	t	20

Table 42. Non-living Ground Cover Characteristics for the *Pinus monophylla/Juniperus osteosperma* Community

Material	Cover % CL
Bare Ground	25.2 ± 16.2
Litter	38.0 ± 8.4
Pavement	19.0 ± 14.2
Rock	17.8

2. *Pinus monophylla/Juniperus osteosperma/ Artemisia nova/Agropyron inerme* Community.

This community is located at the higher elevations in the southwestern part of the watershed. *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* community is found on the east at lower elevations, and *Artemisia nova/Agropyron inerme* or *A. nova/Stipa comata* occur on the pinyon and juniper free slopes.

The yearly precipitation for this community is 11.9 inches (rain can 21, Appendix A). Elevation is around 6650 feet. Aspect is usually northeast. Slope is 25 percent.

Juniper *(J. osteosperma)* and pinyon *(P. monophylla)* cover is fairly low with black sagebrush *(A. nova)* and awnless bluebunch wheatgrass *(A. inerme)* dominant in the understory. Other species like Sandberg bluegrass *(Poa secunda)*, *Gilia ochroleuca*, and *Lomatium macdougalii* are present in small quantities. A variety of forbs, varied in amount, is found scattered throughout the community (Table 43). This community is probably a *Pinus monophylla/Juniperus osteosperma/Artemisia nova/ Agropyron inerme* habitat-type.

Pavement accounts for 34 percent of the non-living ground cover, bare ground for 26 percent, litter for 16 percent and rock for 17 percent (Table 44).

The soil at the macroplots where this vegetation was sampled is a member of a clayey-skeletal, mixed, frigid family of Lithic Mollic Haplargids (Appendix B-19).

Table 43. Species Cover and Frequency for the *Pinus monophylla/Juniperus osteosperma/Artemisia nova/Agropyron inerme* Community

Species	Cover %	12 x 24 Frequency %
Pinus monophylla	4.2	-
Juniperus osteosperma	5.3	-
Artemisia nova	11.3	29
Agropyron inerme	6.3	28
Poa secunda	t	24
Gilia ochroleuca	t	18
Lematium macdougalii	t	17
Eriastrum diffusum	t	7
Agoseris glauca	t	5
Eriogonum cernum	t	5
Descurainia pinnata	t	5
Fritillaria pudica	t	5
Astragalus sp.	t	4
Delphinium andersonii	t	4
Antennaria dimorpha	t	3
Gayophytum ramosissimum	t	3
Sitanion hystrix	t	3
Arabis holboellii	t	t
Calochortus nuttallii	t	t
Chrysothamnus viscidiflorus	t	t
Erigeron pumilus	t	t
Lianthus septentrionalis	t	t
Senecio uintahensis	t	t
Sphaeralcea grossulariaefolia	t	t

Table 44. Non-living Ground Cover Characteristics for the *Pinus monophylla/Juniperus osteosperma/Artemisia nova/Agropyron inerme* Community

Material	Cover %
Bare ground	26.0
Litter	16.0
Pavement	34.0
Rock	17.0

DISCUSSION AND MANAGEMENT SUITABILITIES

High-intensity Management Areas

Winterfat *(Eurotia lanata)* community occurs in the main drainage in the eastern part of the watershed, and in smaller scattered drainages in the northwest and southeast sections of the watershed. This community has been severely abused by sheep to the extent that it is disappearing.

Based on research done at the University of Nevada (Tueller, 1966), halogeton will invade and/or increase in winterfat sites receiving heavy winter use (80 percent or more removal of the current year's growth), but not on those sites moderately (50 percent) or lightly (30 percent) utilized. Winterfat receiving more than 25 percent late winter or early spring utilization also allows halogeton to invade or/and increase.

We recommend that winterfat stands receive "high intensity management." More specifically the recommendation would be to prevent winter grazing in excess of 80 percent of the current year's growth until the winterfat regains its vigor and place in the community. We further recommend that a winter grazing intensity somewhat less than 80 percent be followed in future management programs.

The main drainage in the eastern part of the watershed has been eroded quite badly creating a large gully. A check dam placed about one-fifth the way up the gully has proven successful. The reservoir dam is almost filled with silt. We recommend that a series of well-constructed dams be placed in this gully in order to stop further deterioration and speed healing.

The big sagebrush dominated community *(Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus)* is located in most of the larger drainages and some ravines throughout the watershed. Perennial grasses have all but disappeared from the community allowing rabbitbrush *(C. viscidiflorus* var. *puberulus)* to increase (p.20). This community is suited to seeding with exotic grasses especially at the higher elevations and in the larger draws. Crested wheatgrass *(Agropyron desertorum)* should be used. Precipitation in the community falls in the range of crested wheatgrass requirement. The community is usually found on gradual slopes (3 to 4 percent) with soils usually devoid of pans and other root restrictive layers. The soils have neutral pH, low salt concentration, and fair organic matter and cation exchange capacity. The soils should be prepared with a rangeland plow and drilled to crested wheatgrass in the fall.

A "high intensity management" program would require water development in the form of wells, guzzlers, and/or lined ponds since there are no natural springs or streams in the watershed.

With the proper improvement such as water development, seedings, and fencing, the higher portions of the watershed could be managed for summer cattle grazing with the lower portion of the watershed maintained as sheep and wildlife winter range.

Low-intensity Management Areas

The plant communities contained in this section include all those not mentioned in the previous section. These communities should be managed to maintain or increase the palatable shrubs and grasses such as *Atriplex confertifolia, Grayia spinosa, Artemisia nova, Artemisia spinescens, Agropyron inerme* and *Stipa comata*. These areas should be maintained as a sheep and wildlife winter range.

Ecological Interpretations

Most of the communities in the watershed are seral. Some are in good condition while others are not. Appendix C presents a visual summary of the plant communities and associated soil and is discussed below.

The *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* community has been abused sometime in the past. Perennial grasses have almost disappeared, sagebrush and rabbitbrush have increased. This community at the higher elevations occurs on a well-developed (argillic horizon) fine-loamy, mixed mineralogy soil that has colors dark enough and organic matter high enough for a mollic epipedon (Appendix C). In climax condition this vegetation-soil unit was probably an *A. tridentata/Agropyron inerme* habitat-type. At lower elevations this community occurs on two weakly developed soils. One is a fine-loamy, mixed mineralogy mollic intergrade soil with a cambic horizon and a strongly cemented duripan. The other one is a coarse-loamy, mixed mineralogy mollic intergrade soil with a calcic horizon. The former soil with its vegetation is probably an *A. tridentata/Oryzopsis hymenoides* habitat-type while the latter soil and its vegetation is probably an *A. tridentata/Stipa comata* habitat-type.

Juniperus osteosperma/Artemisia nova, A. nova/Atriplex confertifolia and *Pinus monophylla/J. osteosperma* communities occur on well developed soils (argillic horizon) with a duripan. *J. osteosperma/A. nova* and *A. nova/A. confertifolia* are usually associated with soils that are fine, loamy, mixed mineralogy, mollic intergrades. *A. confertifolia* has probably increased in the *A. nova/A. confertifolia* community. *P. monophylla/J. osteosperma* soils differ from the above only in texture and the degree of cementation of the duripan. This latter vegetative-soils unit is probably a *P. monophylla/J. osteosperma* habitat-type.

Artemisia nova/Agropyron inerme, A. nova/Stipa comata, P. monophylla/J. osteosperma/A. nova/A. inerme and *A. confertifolia* communities occur on well developed soils (argillic horizons) without a duripan. *A. nova/A. inerme* occurs on steep north or east facing slopes and are usually found on loamy-skeletal, mixed mineralogy, mollic intergrade soils while the *A. nova/S. comata* occurs on steep south facing slopes with

fine-loamy, mixed mineralogy, mollic intergrade soils. The *P. monophylla/J. osteosperma/A. nova/A. inerma* community is associated with soils that are shallow (bedrock) clayey-skeletal, mixed mineralogy, mollic intergrade. The pinyon-juniper are probably able to root deep in bedrock fissures. *A. confertifolia* is generally found on soils that are characterized by fine, mixed mineralogy with colors too light and organic matter too low to be a mollic intergrade. This vegetation-soil unit is an *A. confertifolia* habitat-type.

Artemisia nova, C. viscidiflorus var. *puberulus, Artemisia pygmaea, J. osteosperma/A. nova, J. osteosperma* & *A. nova/A. confertifolia* communities occur on weakly developed soils (cambic horizons) with a duripan. *A. nova, C. viscidiflorus* var. *puberulus* and *A. pygmaea* are usually associated with soils that are coarse-loamy, mixed mineralogy, mollic intergrades with indurated duripans. The *C. viscidiflorus* var. *puberulus* is obviously a low seral community. The soils, vegetation, physiographic and climatic data indicate that this communtiy and the *A. nova* community are probably an *A. nova/Oryzopsis hymenoides* habitat-type. *A. pygmaea* is small and usually occurs as inclusions within other communities. There are insufficient data available to distinguish the soils of a probable *A. pygmaea* habitat-type from the soils of the *A. nova/Oryzopsis hymenoides* habitat-type. *J. osteosperma/A. nova* community occurs on similar soils except the duripan is strongly cemented which probably allows some juniper root penetration. *J. osteosperma* is usually associated with soils that are finer textured and have strongly cemented duripans. *A. nova/A. confertifolia* is generally found on a soil characterized as coarse-loamy, mixed mineralogy, mollic intergrade. *A. confertifolia* has probably increased in the community and this vegetation-soil unit is probably an *A. nova* habitat-type.

Juniperus osteosperma/A. nova/A. confertifolia, J. osteosperma/A. tridentata, J. osteosperma/A. nova, A. confertifolia/Eurotia lanata and *Grayia spinosa/Artemisia spinescens* communities occur on weakly developed soils (cambic horizon) without a duripan. Soils associated with *J. osteosperma/A. nova/A. confertifolia* are usually loamy-skeletal and fine-loamy, mixed mineralogy with and without mollic intergrades. *J. osteosperma/A. nova/A. confertifolia* found on the loamy-skeletal and mollic intergrade soils are probably a *J. osteosperma/A. nova* habitat-type where *A. confertifolia* has increased and invaded as a result of *A. nova* decrease. *J. osteosperma/A. tridentata* is usually associated with soils that are clayey-skeletal without durinodes and coarse-loamy with durinodes, mixed mineralogy, mollic intergrades. *J. osteosperma/A. nova* is found associated with similar soils except they are fine-loamy and do not have durinodes. *A. confertifolia/E. lanata* is usually found on similar soils with durinodes, however, they have fine-loamy texture and are mollic intergrades. This community is probably an *E. lanata* habitat-type where *E. lanata* has decreased due to grazing and *A. confertifolia* has increased. Soils associated with *G. spinosa/A. spinescens* are usually coarse-loamy, mixed mineralogy with colors too light and organic matter too low for mollic intergrades. This vegetation-soil unit is probably a habitat-type. *Juniperus osteosperma/A. inerme* and *A. nova/A. confertifolia* communities occur on weakly developed soils with a horizon of secondary carbonate enrichment (calcic horizon).

J. osteosperma/A. inerme is usually found on loamy-skeletal, carbonatic mineralogy, mollic intergrade soils with lithic (bedrock)contact within 20 inches of the soil surface. *A. nova/A. confertifolia* is usually associated with soils that are also loamy-skeletal but have mixed mineralogy with colors too light and organic matter too low for mollic intergrades.

Juniperus osteosperma/Cercocarpus intricatus, J. osteosperma/A. nova/rock, *Eurotia lanata, Descurainia sophia* and *A. tridentata/S. comata* communities occur on soils that are very weakly developed usually with no diagnostic subsurface horizons. *J. osteosperma/C. intricatus* and *J. osteosperma/A. nova*/rock communities are important because of their topographic placement. These communities are located on steep rocky slopes with soils that are especially susceptible to erosion and may function as "high runoff" areas. The soils can be further characterized as having loamy-skeletal, carbonatic mineralogy with lithic contact within 20 inches of the surface and are not mollic intergrades. The *E. lanata* community is a low seral *E. lanata* habitat-type. Winterfat has been abused until halogeton is the primary species in the community. The *D. sophia* community is a depleted *Eurotia lanata* habitat-type that has been abused followed by invasion of annual weeds. Little of the original vegetation remains. These two communities occur on the same deep coarse-loamy, mixed mineralogy soils that are not mollic intergrades. These soils are conducive to accelerated erosion. Soils associated with *A. tridentata/S. comata* are deep sandy, mixed mineralogy. This vegetation-soil unit represents a habitat-type.

It is interesting to note that all communities where juniper occurs are found on weakly developed soil except on the fine-loamy, mixed, frigid family of the mollic durargids at the higher elevations where pinyon and juniper occur together (Appendix C).

CLIMAXES

Climax as used in this bulletin is defined as the kind of community capable of perpetuation under the prevailing climatic, edaphic, physiographic or biotic condition. This definition is in accordance with the polyclimax concept where several climaxes constitute the vegetation in an area as the result of succession.

Climatic climax develops on land (moderately rolling to level) that is neither excessively nor inadequately drained, so that the major environmental conditions affecting organisms are climatic. Physiographic climax is determined in large measure by the nature of the topography (land relief). Edaphic climax is determined largely by the nature of the soil conditions. Physiographic-Edaphic climax is determined mostly by both topography and soils. Biotic climax is determined by the incidence and maintenance of a decisive "biotic factor" such as the continuous heavy grazing by animals.

Most all of the communities in the watershed have been affected greatly by heavy grazing use and areas of relatively undisturbed vegetation are not common. Consequently, a majority of the communities are biotic climaxes. For this reason an estimate of the climax of each community was based on their present condition and probable habitat-type.

Table 45. Type of climaxes associated with the probable habitat-types and present biotic communities in the Duckwater Watershed.

Probable Habitat-Type and Biotic Communities	Type of Climax				
	Climate	Physio-graphic	Edaphic	Physio-graphic-Edaphic	Biotic
A[a] *Artemisia nova/Oryzopsis hymenoides*	X				
1[b] *A. nova*					X
2[b] *A.nova/Atriplex confertifolia*					X
3[b] *Chrysothamnus viscidiflorus* var. *puberulus*					X
B[c] *A. nova/Agropyron inerme*		X			
C[c] *A. nova/Stipa comata*				X	
D[a] *Artemisia pygmaea/O.hymenoides*			X		
1[b] *A. pygmaea*					X
E[c] *Artemisia tridentata/S.comata*			X		
2[b] *A. tridentata/C.viscidiflorus* var. *puberulus*					X
F[a] *A. tridentata/O. hymenoides*			X		
1[b] *A.tridentata/C.viscidiflorus* var. *puberulus*					X
G[a] *A. tridentata/A.inerme*		X			
1[b] *A.tridentata/C.viscidiflorus* var. *puberulus*					X
H[a] *Eurotia lanata/O.hymenoides*			X		
1[b] *E. lanata*					X
2[b] *A.confertifolia/E.lanata*					X
3[b] *Descurainia sophia*					X
I[c] *Grayia spinosa/Artemisia spinescens*		X			
J[c] *Juniperus osteosperma*		X			
K[a] *J. osteosperma/A.nova/O.hymenoides*				X	
1[b] *J.osteosperma/A.nova/A. confertifolia*					X
2[b] *J.osteosperma/A.nova*					X
L[a] *J.osteosperma/A.tridentata/ O.hymenoides*				X	
1[b] *J.osteosperma/A.tridentata*					X
M[c] *J. osteosperma/A.nova/*rock				X	
N[c] *J. osteosperma/A.inerme*				X	
O[c] *J.osteosperma/Cercocarpus intricatus*				X	
P[c] *Pinus monophylla/J.osteosperma*				X	
Q[c] *P.monophylla/J.osteosperma/A. nova/A.inerme*				X	

[a] Theoretical unit (habitat-type)
[b] Real unit (present biotic community)
[c] Theoretical and real unit.

Recreation

The watershed is located far from any large population. At the present time this remoteness makes the watershed of little value for recreational development with the exception of deer hunting. But as the population pressure is increased and wide-open space demands a greater premium, then a more intense use or demand may develop in this watershed.

The watershed contains certain features that may intrigue the biologist or recreationist. (1) Ecology features: plant communities like *Juniperus osteosperma/Cercocarpus intricatus* and *Artemisia nova/Agropyron inerme* are unique and interesting. The pinyon-juniper woodland found in the watershed would provide good camp sites, however, water is lacking. (2) Scenic: the grandeur of the vegetation, topographic features, and wide-open spaces may attract a certain type of recreationist. (3) Hunting and miscellaneous uses such as rock collecting are also possibilities.

Research Needs

Duckwater watershed lends itself to several problem areas that need further study. A few of these are:

1. Means, feasibility and requirements for restoring "beat-out" communities like *Chrysothamnus viscidiflorus* var. *puberulus* to some higher producing forage and soil holding vegetation.

2. Means, feasibility and requirements of establishing grasses in *Artemisia nova* communities.

3. Means, feasibility and requirements of establishing *Eurotia lanata* back into its own habitat-type.

4. Means, feasibility and requirements of soil stabilization in communities where accelerated erosion is a problem, such as *Juniperus osteosperma/Cercocarpus intricatus*, *Juniperus osteosperma/Artemisia nova*/rock and *Pinus monophylla/Juniperus osteosperma* communities.

5. Engineering requirements and feasibility of placing check dams in *Eurotia lanata* soils which are very erosive.

6. A detailed soil survey and study to determine soil boundaries, to further explain the difference between soils and to explore in detail why certain plants are associated with certain soils.

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APPENDIX A. Precipitation data for the Duckwater Watershed.

Rain can	Mean* Precip. Inches	Rain can	Mean* Precip. Inches
1	11.6	13	10.7
2	11.9	14	10.2
3	11.0	15	12.0
4	11.0	16	13.7
5	11.0	17	11.8
6	9.8	18	11.2
7	9.4	19	10.4
8	9.3	20	10.8
9	8.4	21	11.9
10	7.8	22	10.1
11	8.2	23	11.2
12	8.0	24	10.5
		Mean	10.5

* Mean precipitation is based on a 3-year average, 1963-1965

APPENDIX A (cont'd)

Community	Mean* Precip. Inches
Artemisia nova	10.6
Artemisia nova/Agropyron inerme	11.2
Artemisia nova/Atriplex confertifolia	10.1
Artemisia nova/Stipa comata	11.6
Artemisia tridentata/Chrysothamnus viscidiflorus var. *puberulus*	11.2
Artemisia pygmaea	7.8
Artemisia tridentata/Stipa comata	11.9
Atriplex confertifolia	10.0
Atriplex confertifolia/Eurotia lanata	9.4
Chrysothamnus viscidiflorus var.*puberulus*	8.6
Eurotia lanata	9.4
Descurainia sophia	10.8
Grayia spinosa/Artemisia spinescens	8.4
Juniperus osteosperma	10.6
Juniperus osteosperma/Artemisia nova	11.1
Juniperus osteosperma/Artemisia tridentata	10.5
Juniperus osteosperma/Artemisia nova/ Atriplex confertifolia	11.2
Juniperus osteosperma/Artemisia nova/rock	11.2
Juniperus osteosperma/Agropyron inerme	10.5
Juniperus osteosperma/Cercocarpus intricatus	11.2
Pinus monophylla/Juniperus osteosperma	12.8
Pinus monophylla/Juniperus osteosperma/ Artemisia nova/Agropyron inerme	11.9

*The mean precipitation is based on rain cans in or near each community and on a 3-year record, 1963-1965.

APPENDIX B - Soil Families and Subgroups as Associated with the Duckwater Watershed Plant Communities.

Appendix B-1

Sandy, mixed, frigid family of the Typic Torripsamments

These soils are found at elevations from 6430 to 6520 feet and associated with *Artemisia tridentata/Stipa comata* community. They are usually found on northeast facing slopes but may occur on north facing slopes. The slopes range from 1 to 4 percent with undulating macrorelief and uniform microrelief. These soils belong to the B hydrologic group with a soil profile water holding capacity of 5.8 inches for the first 72 inches. Stoniness class 0.

A 11	0-2"	Pale brown (10YR6/3) loamy sand, dark grayish brown (10YR4/2) moist; moderate medium platy; weakly coherent, very friable, nonsticky, nonplastic; organic matter 1.0 percent, conductivity 0.15 mmhos., cation exchange capacity 12.8 meq.; noneffervescent; neutral (pH 7.1).
A 12	2-14"	Pale brown (10YR6/3) loamy sand, dark brown (10YR3/3) moist, weak coarse platy; weakly coherent, very friable, nonsticky, nonplastic; noneffervescent.
C1ca	14-31"	Very pale brown (10YR7/3) loamy sand, dark yellowish brown (10YR3/4) moist; massive; slightly hard, friable, nonsticky, nonplastic; violently effervescent.
C2	31"+	Very pale brown (10YR7/3) loamy sand, dark yellowish brown (10YR3/4) moist; massive; weakly coherent, very friable, nonsticky, nonplastic; strongly effervescent.

Appendix B-2

Coarse-loamy, mixed, frigid family of the Typic Torriorthents

These soils are found at elevations from 5800 to 6100 feet and are associated with *Eurotia lanata* and *Descurainia sophia* communities. They are usually found on south or southeast facing slopes but may occur on southwest facing slopes. The slopes range from 1 to 2 percent with flat macrorelief and uniform microrelief. These soils belong to the D hydrologic group due to platy structure, and have a waterholding capacity of 8.1 inches for the first 72 inches of the soil. Stoniness class 0. This soil is one of the big sediment producers, gullys are always developing.

A 1	0-6"	Pale brown (10YR6/3) sandy loam, yellowish brown (10YR5/4) moist; moderate medium platy; slightly hard, friable, nonsticky, nonplastic; organic matter 0.4 percent, conductivity 0.4 mmhos., cation exchange capacity 11.8 meq.; violently effervescent; mildly alkaline (pH 7.7).

C_1	6-22"	Very pale brown (10YR7/3) sandy clay loam, yellowish brown (10YR5/4) moist; massive; slightly hard, firm slightly sticky, nonplastic; violently effervescent.
C_2	22-29"+	Very pale brown (10YR7/3) sandy loam, yellowish brown (10YR5/4) moist; massive; slightly hard, friable, nonsticky, nonplastic; violently effervescent.

Appendix B-3

Loamy-skeletal, carbonatic, frigid family of the Lithic Torriorthents.

These soils are found at elevations from 6200 to 6500 feet and are associated with *Juniperus osteosperma/Artemisia nova*/rock and *Juniperus osteosperma/Cercocarpus intricatus* communities. They are usually found on east or west facing slopes but may be found on north or south facing slopes. The slopes range from 30 to 50 percent with inclusions of 15 to 30 percent along the ridges and with mountainous macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 0.8 inch. Stoniness class 4.

A 1	0-6"	Pale brown (10YR6/3) loam, yellowish brown (10YR5/4) moist; moderate medium granular; friable, slightly sticky, slightly plastic; organic matter 1.3 percent, conductivity 0.4 mmhos., cation exchange capacity 17.8 meq.; strongly effervescent; mildly alkaline (pH 7.5).
R	6" +	Dolomite bedrock

Appendix B-4

Loamy-skeletal, mixed, frigid family of the Typic Calciorthids.

These soils are found at elevations around 6500 feet and associated with *Artemisia nova/Atriplex confertifolia* community. They are usually found on west facing slopes. The slopes are about 9 percent with undulating macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 3.9 inches. Stoniness class 0.

A 11	0-2"	Light gray (10YR7/2) silt loam, brown (10YR4/3)moist; moderate fine platy; weakly coherent, very friable, slightly sticky, slightly plastic; organic matter 1.12 percent, conductivity 0.2 mmhos, cation exchange capacity 19.4 meq.; violently effervescent; mildly alkaline (pH 7.7). 65 percent particles coarser than 2 mm; vescular pores.

A 12	2-7"	Very pale brown (10YR7/3) silt loam, dark yellowish brown (10YR4/4) moist; weak coarse platy; weakly coherent, very friable, slightly sticky, slightly plastic, violently effervescent; 40 percent particles coarser than 2 mm.
$C_{1\ ca}$+	7-16"	Very pale brown (10YR7/3) silt loam, yellowish brown (10YR5/4) moist; weak coarse prismatic; weakly coherent, very friable, slightly plastic; organic matter 0.96 percent, conductivity 0.6 mmhos; violently effervescent; moderately alkaline (pH 8.0); calcium carbonate accumulation on gravel and cobbles; 50 percent particles coarser than 2 mm.
C	16-28"	Very pale brown (10YR7.3) fine sandy loam, yellowish brown (10YR5.4) moist; massive; weakly coherent, very friable, nonsticky, nonplastic; violently effervescent; 80 percent particles coarser than 2 mm.

+ C_{1ca} Calcic horizon

Appendix B-5

Loamy-skeletal, carbonatic, frigid family of the Mollic Calciorthids

These soils are found at elevations around 6200 feet and are associated with *Juniperus osteosperma/Agropyron inerme* community. They are usually found on northeast facing slopes. The slopes range from 15 to 22 percent with mountainous macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 1.5 inches. Stoniness class 4.

A 1	0-4"	Light brownish gray (10YR6/2) fine sandy loam, brown (10YR4/3) moist; weak fine granular; weakly coherent, very friable, nonsticky, nonplastic; organic matter 2.5 percent, conductivity 0.2 mmhos., cation exchange capacity 30.5 meq.; violently effervescent; mildly alkaline (pH 7.5).
C_{ca}+	4-18"	Limestone cobbles coated with lime and fine sandy loam mixed among the cobbles.
R_2	18" +	Limestone bedrock

+ C_{ca} Calcic horizon

Coarse-loamy, mixed, frigid family of the Mollic Calciorthids

These soils are found at elevations around 6400 feet and associated with *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* community at lower elevations. They are generally found on south or east facing slopes. The slopes are 3 percent with undulating macrorelief and convex microrelief. The soil belongs to the B hydrologic group with a soil profile water holding capacity of 2.9 inches. Stoniness class 1.

A 1	0-6"	Brown (7.5YR4/2) moist; sandy loam; weak fine platy; weakly coherent, very friable, nonsticky, nonplastic; organic matter 0.45 percent, conductivity 0.1 mmhos., cation exchange capacity 20.0 meq.; noneffervescent; mildly alkaline (pH 7.4); vesicular pores upper 2 inches.
B 2*	6-11"	Brown (7.5YR4/4) moist; fine sandy loam; weak medium subangular blocky;weakly coherent, very friable, slightly sticky, slightly plastic; strongly effervescent.
Cca+	11-28"+	Pink (7.5YR7/4) moist; sandy loam; massive; slightly hard; friable, slightly sticky, slightly plastic; violently effervescent.

+ Calcic horizon
* Cambic horizon

Coarse-loamy, mixed, frigid family of the Typic Camborthids

These soils are found at elevations from 5800 to 5830 feet and are associated with *Grayia spinosa/Artemisia spinescens* community. They are usually found on east facing slopes. The slopes range from 1 to 2 percent with flat macrorelief and uniform microrelief. These soils belong to the B hydrologic group with a soil profile water holding capacity of 3.2 inches. Stoniness class 0.

A 1	0-3"	Dark grayish brown (10YR4/2) moist; sandy loam; weak fine platy; weakly coherent, nonsticky, nonplastic; organic matter 0.6 percent, conductivity 0.2 mmhos., cation exchange capacity 11.2 meq.; slightly effervescent; neutral (pH 6.7).
B 2*	3-18"	Brown (10YR4/3) moist; sandy loam; massive; weakly coherent, very friable, nonsticky, nonplastic; slightly effervescent; moderately alkaline (pH 8.2).
B 3*	18-24"	Brown (10YR4/3) moist; sandy loam; massive; weakly coherent, very friable, nonsticky, nonplastic; violently effervescent; moderately alkaline (pH 8.2).

C	24-20"+	Brown (10YR5/3) moist; sandy loam; massive; weakly coherent, very friable, nonsticky, nonplastic; strongly effervescent.

* Cambic horizon

Appendix B-8

Fine-loamy, mixed, frigid family of the Typic Camborthids

These soils are found at elevations around 6500 feet and associated with *Juniperus osteosperma/Artemisia nova/Atriplex confertifolia* community. They are usually found on east facing slopes. The slopes are 8 percent with undulating macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 2.7 inches. Stoniness class 3.

A 11	0-1"	Light gray (10YR7.3) clay loam, yellowish brown (10YR5/4) moist; weak very thin platy; very friable, sticky, plastic; organic matter 0.7 percent, conductivity 0.5 mmhos., cation exchange capacity 15.5 meq.; slightly effervescent; neutral (pH 7.0); vesicular pores.
A 12	1-4"	Light gray (10YR7/2) clay, yellowish brown (10YR5/4) moist; strong very fine granular; very friable, very sticky, very plastic; slightly effervescent.
B 2*	4-10"	Brown (10YR4/3) moist; clay, moderate medium granular; friable, very sticky, very plastic; strongly effervescent:
$C1_{ca}$	10-21"	Brown (10YR4/3) moist; clay loam; massive; friable, sticky, plastic; violently effervescent.
C 2	21"+	Weathered shale.

* Cambic horizon

Appendix B-9

Fine-loamy, mixed, frigid family of the Duric Camborthids

These soils are found at elevations from 6375 to 6400 feet and associated with *Atriplex confertifolia/Eurotia lanata* community. They are usually found on west facing slopes but may occur on southwest facing slopes. The slopes range from 1 to 5 percent with undulating macrorelief and uniform microrelief. These soils belong to D hydrologic group with a soil profile water holding capacity of 4.7 inches. Stoniness class is 0.

A 1	0-2"	Light gray (10YR7/2) silt loam, brown (10YR4/3) moist; moderate fine platy; slightly hard, very friable, slightly sticky, slightly plastic; organic matter 0.9 percent, conductivity 0.4 mmhos., cation exchange

		capacity 17.0 meq.; violently effervescent; mildly alkaline (pH 7.8); vesicular pores.
B 2*	2-10"	Very pale brown (10YR7/3) clay loam, brown (10YR4/3) moist; weak coarse prismatic; slightly hard, very friable, sticky, plastic; violently effervescent.
B 3*	10-21"	Very pale brown (10YR7/3) clay loam, dark yellowish brown (10YR4/4) moist; moderate coarse prismatic; slightly hard, very friable, sticky, plastic; organic matter 0.9 percent, conductivity 0.4 mmhos.; violently effervescent; mildly alkaline (pH 7.5).
C	21-31"+	Very pale brown (10YR7.3) dry, brown (10YR4/3) moist; silt loam; massive; slightly hard, very friable, slightly sticky, slightly plastic; violently effer-vercent; durinodes.

* Cambic horizon

Appendix B-10

Coarse-loamy, mixed, frigid, shallow, family of the Duric Mollic Camborthids

These soils are found at elevations of 6350 to 6500 feet and are associated with *Juniperus osteosperma/Artemisia tridentata* community. They are usually found on southeast facing slopes. The slopes range from 2 to 4 percent with undulating macrorelief and uniform microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 2.9 inches. Stoniness class 0.

A 1	0-4"	Light brownish gray (10YR6/2) silt loam, brown (10YR4/3) moist; moderate fine granular; weakly coherent, very friable, slightly sticky, slightly plastic; organic matter 2.5 percent, conductivity 0.2 mmhos., cation exchange capacity 23.0 meq.; noneffervescent; mildly alkaline (pH 7.7).
B 2*	4-12"	Pale brown (10YR6/3) silt loam, dark yellowish brown (10YR4/4) moist; moderate medium prismatic; slightly hard, friable, slightly sticky, slightly plastic; organic matter 1.2 percent, conductivity 0.5 mmhos.; violently effervescent; mildly alkaline (pH 7.5).
C_1	13-18"	Very pale brown (10YR7/3) silt loam, dark brown (10YR3/3) moist; massive; hard, firm, slightly sticky, slightly plastic; violently effervescent; durinodes.
R	18"+	Shale

* Cambic horizon

Fine-loamy, mixed, frigid family of the Mollic Camborthids

These soils are found at elevations around 6000 feet and are associated with *Juniperus osteosperma/Artemisia nova* community. They are usually found on east or southeast facing slopes. The slopes range from 3 to 9 percent with rolling macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 4.1 inches. Stoniness class 1.

A 1	0-3"	Pale brown (10YR6/3) clay loam, grayish brown (10YR5/2) moist; weak medium granular; weakly coherent, very friable, sticky, plastic; organic matter 2.5 percent, conductivity 0.2 mmhos., cation exchange capacity 18.2 meq.; strongly effervescent; mildly alkaline (pH 7.6).
B 2*	3-8"	Light reddish brown (5YR6/4) moist; clay loam; weak medium prismatic; weakly coherent, very friable, sticky, plastic; violently effervescent.
C	11-25"+	Reddish yellow (7.5YR6/6) moist;clay loam; massive; slightly hard, very friable, slightly sticky, slightly plastic;violently effervescent

* Cambic horizon

Clayey-skeletal, mixed, frigid, shallow family of the Mollic Camborthids

These soils are found at elevations of 5400 to 6350 feet and are associated with *Juniperus osteosperma/Artemisia tridentata* community. They are usually found on southeast facing slopes. The slopes range from 4 to 7 percent with rolling macrorelief and convex microrelief. This soil belongs to the D hydrologic group with a soil profile water holding capacity of 3.7 inches. Stoniness class 1.

A 11	0-1"	Light gray (10YR7/2) clay, weak red (2.5YR5/2) moist; moderate fine platy; weakly coherent, very friable, very sticky, very plastic; organic matter 1.1 percent, conductivity 0.2 mmhos., cation exchange capacity 22.5 meq.; violently effervescent; mildly alkaline (pH 7.5).
A 12	1-5"	Light gray (10YR7/2) clay, reddish brown (10YR5/4) moist; moderate medium prismatic; weakly coherent, very friable, very sticky, very plastic; violently effervescent.
B 2*	5-20"	Shale with lime coating and clay loam in the interspaces.
C	20"+	Weathered shale.

* Cambic horizon

Appendix B-13

Loamy-skeletal, mixed, frigid, shallow family of the Mollic Camborthids

These soils are found at elevations from 6100 to 6600 feet and associated with *Juniperus osteosperma/Artemisia nova/Atriplex confertifolia* community. They are usually found on west, southwest or southeast facing slopes. The slopes range from 3 to 18 percent with mountainous or undulating macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 3.2 inches. Stoniness is class 0.

A 11	0-1"	Pale brown (10YR6/3) clay loam, brown (10YR4/3) moist; strong fine platy; slightly hard, very friable, very sticky, very plastic; organic matter 1.7 percent, conductivity 0.3 mmhos., cation exchange capacity 17.0 meq.; slightly effervescent; mildly alkaline (pH 7.6).
A 12	1-5"	Light yellowish brown (10YR6/4) clay loam, dark yellowish brown (10YR4/4) moist; moderate coarse platy; slightly hard, very friable, very sticky, very plastic; violently effervescent.
B 2*	5-18"	Shale with lime coatings and clay loam in the interspaces.

* Cambic horizon

Appendix B-14

Coarse-loamy, mixed, frigid family of the Entic Mollic Durorthids

These soils are found at elevations around 6500 feet and associated with *Artemisia nova/Atriplex confertifolia* community. They are usually found on west facing slopes. The slopes are about 3 percent with undulating macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 2.6 inches. Stoniness class is 0.

A 1	0-3"	Very pale brown (10YR7/3) fine sandy loam, brown (10YR4.3) moist; moderate fine platy; weakly coherent, very friable, nonsticky, nonplastic; organic matter 1.7 percent, conductivity 0.2 mmhos, cation exchange capacity 17.0 meq.; violently effervescent; mildly alkaline (pH 7.7); vesicular pores.
B 2*	3-11"	Very pale brown (10YR7/4) fine sandy loam; yellowish brown (10YR5/4) moist; massive; weakly coherent, very friable, nonsticky, nonplastic; violently effervescent, silica and calcium accumulation on gravel and cobbles.

C_1	11-21"	Very pale brown (10YR8/4) fine sandy loam, pale brown (10YR6/3) moist; massive; hard, firm, nonsticky, nonplastic; violently effervescent; durinodes.
C_{2casim}	21"+	Strongly cemented duripan.

* Cambic horizon

Appendix B-15

Fine-loamy, mixed,frigid family of the Entic Mollic Durorthids

These soils are found at elevations from 6250 to 6400 feet and associated with *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* community at lower elevations and *Juniperus osteosperma* community. They are generally found on north or east facing slopes. The slopes range from 2 to 5 percent with undulating macrorelief and uniform or convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 3.7 inches. Stoniness class 1.

A 1	0-7"	Reddish brown (5YR4/3) moist; fine sandy loam; weak medium subangular blocky; weakly coherent; very friable, nonsticky, nonplastic; organic matter 1.7 percent, conductivity 0.2 mmhos., cation exchange capacity 24.5 meq.; violently effervescent; neutral (pH 7.3).
B 2*	7-13"	Brown (7.5 YR5/4) moist, clay loam; medium moderate prismatic; weakly coherent, very friable, sticky, plastic; organic matter 2.4 percent, conductivity 0.2 mmhos.; violently effervescent; mildly alkaline (pH 7.5).
B 3*	13- 21"	Pink (7.5YR7/4) moist; silt loam; massive, hard, friable, slightly sticky, slightly plastic; violently effervescent; few durinodes.
C_{sicam}	21"+	Strongly cemented duripan.

* Cambic horizon

Appendix B-16

Coarse-loamy, mixed, frigid family of the Entic Mollic Durorthids

These soils are found at elevations of 6150 feet and are associated with *Juniperus osteosperma/Artemisia nova* community. They are usually found on east facing slopes. The slopes are 5 to 17 percent with rolling macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 2.4 inches. Stoniness class 2.

A 11	0-2"	Light gray (10YR7/2) fine sandy loam, dark yellowish brown (10YR4/4) moist; strong fine platy; weakly coherent, very friable, slightly sticky, nonplastic; organic matter 1.2 percent, conductivity 0.2 mmhos., cation exchange capacity 23.2 meq.; noneffervescent; mildly alkaline (pH 7.6); vesicular pores.
B 2*	2-11"	Pale brown (10YR6/3) fine sandy loam, dark yellowish brown (10YR4/4) moist; weak fine granular; weakly coherent; very friable, nonsticky, nonplastic, violently effervescent.
C_{ca}	11-23"	Very pale brown (10YR7/3) fine sandy loam, light brownish gray (10YR6/2) moist; weakly coherent, very friable, nonsticky, nonplastic; violently effervescent.
C_{casim}	23" +	Strongly cemented duripan.

* Cambic horizon

Appendix B-17

Coarse-loamy, mixed, frigid family of the Mollic Durorthids

These soils are found at elevations from 5900 to 6500 feet, and associated with *Artemisia nova*, *Artemisia pygmaea*, and *Chrysothamnus viscidiflorus* var. *puberulus* communities. They are generally found on east or northeast facing slopes but may occur on west or northwest facing slopes. The slopes range from 1 to 7 percent with hilly or undulating macrorelief and uniform or convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 2.5 inches. Stoniness class 1.

A 1	0-4"	Light gray (10YR7/2) silt loam, dark yellowish brown (10YR4/4) moist; strong fine platy; slightly sticky, slightly plastic; organic matter 1.7 percent conductivity 0.3 mmhos., cation exchange capacity 15.8 meq.; strongly effervescent; mildly alkaline (pH 7.6); vesicular pores.
B 2*	4-14"	Very pale brown (10YR7/4) silt loam, dark yellowish brown (10YR4/4) moist; weak medium prismatic; slightly hard, very friable, slightly sticky, slightly plastic; organic matter 0.7 percent, conductivity 0.2 mmhos.; violently effervescent; mildly alkaline (pH 7.8).
C_{Sicam}	15" +	Indurated duripan.

* Cambic horizon

Fine, mixed, frigid family of the Typic Haplargids

These soils are found at elevations from 6350 to 6600 feet and associated with *Atriplex confertifolia* community. They are usually found on east facing slopes but may occur on south facing slopes. The slopes range from 4 to 30 percent with undulating or hilly macrorelief and uniform or convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 7.9 inches. Stoniness class is 1.

A 1	0-3"	Very pale brown (10YR7/3) fine sandy loam, yellowish brown (10YR5/4) moist; weak fine granular; friable, slightly sticky, nonplastic; organic matter 0.8 percent, conductivity 2.0 mmhos.; cation exchange capacity 9.0 meq.; neutral (pH 7.3); vesicular pores.
B 21t**	3-9"	Yellowish brown (10YR5/4) clay, dark yellowish brown (10YR4/4) moist; strong, very fine subangular blocky; friable, very sticky, very plastic.
B 22t	9-20"	Reddish brown (2.5YR5/4) clay, weak red (2.5YR4/2) moist; moderate medium prismatic; firm, very sticky, very plastic; organic matter 0.6 per cent, conductivity 6.5 mmhos.; mildly alkaline (pH 7.4).
B 3	20-43"+	Pale red (2.5YR6/2) clay, reddish brown (2.5YR4/4) moist; massive; firm, very sticky, very plastic.

** Argillic horizon

Clayey-skeletal, mixed, frigid family of the Lithic Mollic Haplargids

These soils are found at elevations around 6650 feet and associated with *Pinus monophylla/Juniperus osteosperma/Artemisia nova/Agropyron inerme* community. They are usually found on northeast facing slopes. The slopes are 25 percent with mountainous macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 2.2 inches. Stoniness class is 4.

A 1	0-4"	Pale brown (10YR6/3) sandy clay loam, brown (10YR4/3) moist; massive; slightly hard, very friable, sticky, plastic; noneffervescent; neutral (pH 7.0).
B 2t**	4-11"	Brown (10YR4/3) moist; sandy clay, moderate medium prismatic; hard, firm, sticky, plastic, noneffervescent; neutral (pH 7.0).
R	11" +	Bedrock

** Argillic horizon

Fine-loamy, mixed, frigid family of the Mollic Haplargids

These soils are found at elevations from 6400 to 6550 feet and associated with *Artemisia nova/Stipa comata* community. They are generally found on south facing slopes. The slopes range from 13 to 24 percent with hilly macrorelief and convex microrelief. These soils belong to the C hydrologic group with a soil profile water holding capacity of 3.6 inches. Stoniness class is 4.

A 1	0-5"	Very pale brown (10YR7/3) sandy loam, dark grayish brown (10YR4.2) moist; weak fine granular; weakly coherent, very friable, nonsticky, nonplastic; organic matter 1.4 percent, conductivity 0.3 mmhos., cation exchange capacity 11.0 meq.; noneffervescent; neutral (pH 7.)); vesicular pores.
B 1	5-10"	Pale brown (10YR6/3) loam, brown (10YR4/3) moist; weak medium subangular blocky; weakly coherent, very friable, slightly sticky, plastic; noneffervescent.
B 2t**	10-16"	Pale brown (10YR6/3) sandy clay, brown (10YR4/3) moist; moderate medium subangular blocky; slightly hard, firm, sticky, plastic; organic matter 0.8 percent, conductivity 0.2 mmhos.; noneffervescent; neutral (pH 7.1).
C	16-24"+	Light yellowish brown (10YR6/4) sandy clay loam, dark yellowish brown (10YR4/4) moist; massive; hard, friable, sticky, slightly plastic; noneffervescent.

** Argillic horizon

Loamy-skeletal, mixed, frigid family of the Mollic Haplargids

These soils are found at elevations from 6125 to 6650 feet and associated with *Artemisia nova/Agropyron inerme* community. They are usually found on north or east facing slopes. The slopes range from 25 to 39 percent with mountainous macrorelief and convex microrelief. These soils belong to the C hydrologic group with a soil profile water holding capacity of 4.6 inches. Stoniness class is 4.

A 1	0-6"	Light brownish gray (10YR6/2) sandy loam, dark grayish brown (10YR4/2) moist; moderate medium platy; weakly coherent, very friable, slightly sticky, slightly plastic; organic matter 1.2 percent, conductivity 0.2 mmhos., cation exchange capacity 12.2 meq.; noneffervescent; neutral (pH 7.3); 70 percent particles coarser than 2 mm.

B2t**	6-18"	Dark yellowish brown (10YR4/4) moist; sandy clay; medium moderate prismatic; hard, friable, very sticky, very plastic; organic matter 1.1 percent, conductivity 0.3 mmhos., noneffervescent; mildly alkaline (pH 7.4); 50 percent particles coarser than 2 mm.
B 3	18-23"	Dark yellowish brown (10YR4/4) moist; sandy clay loam; massive; slightly hard, friable, slightly sticky, slightly plastic; noneffervescent; 70 percent particles coarser than 2 mm.
C	23-30" +	Brown (10YR5/3) moist; fine sandy loam; massive; weakly coherent, very friable, nonsticky, nonplastic, strongly effervescent; 80 percent particles coarser than 2 mm.

** Argillic horizon

Appendix B-22

Fine-loamy, mixed, frigid family of the Haplic Mollic Durargids

These soils are found at elevations around 6800 feet and are associated with *Pinus monophylla/Juniperus osteosperma* community. They are usually found on southeast facing slopes. The slopes range from 13 to 15 percent with mountainous macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 3.8 inches. Stoniness class is 4.

A 1	0-8"	Grayish brown (10YR5/2) clay loam, very dark grayish brown (10YR3/2) moist; moderate fine to weak medium platy; weakly coherent, very friable, slightly sticky, slightly plastic; organic matter 2.2 percent, conductivity 0.1 mmhos., cation exchange capacity 20.0 meq.; noneffervescent; neutral (pH 7.2).
B 2t**	8-12"	Light yellowish brown (10YR6/4) clay, brown (10YR4/3) moist; moderate medium prismatic; hard, friable, very sticky, very plastic; organic matter 1.1 percent, conductivity 0.1 mmhos.; noneffervescent; neutral (pH 7.2).
B 3t**	12-22"	Very pale brown (10YR7/3) clay loam, brown (10YR4/3) moist, massive; slightly hard, firm, slightly sticky, plastic; noneffervescent.
C_{sicam}	22"+	Strongly cemented duripan

** Argillic horizon

Fine, mixed, frigid family of the Mollic Durargids

These soils are found at elevations around 6700 feet and are associated with *Pinus monophylla/Juniperus osteosperma* community. They are usually found on east or south facing slopes. The slopes range from 6 to 8 percent with mountainous macrorelief and convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 2.3 inches. Stoniness class is 2.

A 1	0-3"	Light brownish gray (10YR6/2) sandy loam, very dark grayish brown (10YR3/2) moist; moderate fine platy; slightly hard, very friable, nonsticky, nonplastic; organic matter 2.2 percent, conductivity 0.1 mmhos., cation exchange capacity 16.5 meq.; noneffervescent; neutral (pH 6.9).
B2t**	3-13"	Light brownish gray (10YR6/2) clay, reddish brown (5YR4/4) moist; moderate coarse prismatic; hard, friable, very sticky, very plastic; organic matter 1.5 percent, conductivity 0.2 mmhos.; noneffervescent; neutral (pH 6.7).
C_{sicam}	13" +	Indurated duripan

** Argillic horizon

Fine-loamy, mixed, frigid family of the Mollic Durargids

These soils are found at elevations from 5900 to 6250 feet and are associated with *Artemisia nova/Atriplex confertifolia* and *Juniperus osteosperma/Artemisia nova* communities. They are usually found on south or east facing slopes. The slopes are about 3 percent with undulating macrorelief and uniform or convex microrelief. These soils belong to the D hydrologic group with a soil profile water holding capacity of 3.4 inches. Stoniness class is 0.

A 1	0-6"	Dark grayish brown (10YR4/2) moist; sandy loam; moderate medium platy; weakly coherent, very friable, nonsticky, nonplastic; organic matter 0.7 percent, conductivity 0.2 mmhos., cation exchange capacity 10.0 meq.; strongly effervescent; mildly alkaline (pH 7.6), vesicular pores upper 2 inches.
B 2t**	6-14"	Brown (7.5YR5/4) moist; clay; moderate, medium subangular blocky; slightly hard, friable, very sticky very plastic; organic matter 0.6 percent, conductivity 0.3 mmhos.; strongly effervescent; mildly alkaline (pH 7.5).

B 3ca 14-18" Brown (7.5YR5/4) moist, sandy loam; massive; slightly hard, friable, slightly sticky, slightly plastic; violently effervescent.

C_{sicam} 18" + Indurated duripan.

** Argillic horizon

Fine-loamy, mixed, frigid family of the Calcic Argixerolls

These soils are found at elevations around 6700 feet and are associated with *Artemisia tridentata/Chrysothamnus viscidiflorus* var. *puberulus* community at higher elevations. They are generally found on east or west facing slopes. The slopes are 2 to 6 percent with undulating macrorelief and convex microrelief. The soils belong to the B hydrologic group with a soil profile water holding capacity of 3.3 inches. Stoniness class is 1.

A 1 0-6" Dark brown (10YR3/3) moist; loam; weak medium platy; weakly coherent, very friable, slightly sticky, slightly plastic; noneffervescent.

B 2t**6-12" Dark brown (10YR3/3) moist, sandy clay loam; massive; weakly coherent, very friable, sticky, plastic, strongly effervescent.

Cca 12-27" + Brown (10YR4/3) moist, sandy loam; massive; weakly coherent, very friable, nonsticky, nonplastic; violently effervescent.

** Argillic horizon

APPENDIX C

VEGETATION AND SOILS ASSOCIATION TABLE

Communities	Torripsamments	Torriothents		Calciorthids			Durorthids		
	Sandy,mixed,frigid family of the Typic Torripsamments	Coarse-loamy,mixed,frigid family of the Typic Torriorthents	Loamy-skeletal,carbonatic frigid family of the Lithic Torriorthents	Loamy-skeletal,mixed,frigid family of the Typic Carciorthids	Loamy-skeletal,carbonatic, frigid family of the Lithic Mollic Calciorthids	Coarse-loamy,mixed,frigid family of the Mollic Calciorthids	Coarse-loamy,mixed,frigid family of the Entic Mollic Durorthids	Fine-loamy,mixed,frigid family of the Entic Mollic Durorthids	Coarse-loamy,mixed,frigid family of the Mollic Durorthids
A. nova									X
A. nova/ A. inerme									
A. nova/ A. confertifolia				X			X		
A. nova/ Stipa comata									
A. pygmaea									X
A. tridentata/ C.v. var. *puberulus*						X	X		
A. tridentata/ Stipa comata	X								
A. confertifolia									
A. confertifolia/ Eurotia lanata									
C.v. var. *puberulus*									X
Eurotia lanata		X							
Descurainia sophia		X							
Grayia spinosa/ A. spinescens									
J. osteosperma								X	
J. osteosperma/ A. nova							X		
J. osteosperma/ A. tridentata									
J. osteosperma/A. nova/ A. confertifolia									
*J. osteosperma/ A. nova/*rock			X						
J. osteosperma/ A. inerme					X				
J. osteosperma/ C. intricatus			X						
P. monophylla/ J. osteosperma									
P. monophylla/J.osteosperma/A.nova/A.inerme									

									X													Coarse-loamy,mixed,frigid family of the Typic Camborthids	Camborthids
					X																	Fine-loamy,mixed,frigid family of the Typic Camborthids	
													X									Fine-loamy,mixed,frigid family of the Duric Camborthids	
						X																Coarse-loamy,mixed,frigid, shallow family of the Duric Mollic Camborthids	
							X															Fine-loamy,mixed,frigid family of the Mollic Camborthids	
						X																Clayey-skeletal,mixed, frigid family of the Mollic Camborthids	
					X																	Loamy-skeletal,mixed, frigid,shallow family of the Mollic Camborthids	
													X									Fine, mixed, frigid family of the Typic Haplargids	Haplargids
X																						Clayey-skeletal,mixed, frigid family of the Lithic Mollic Haplargids	
																	X					Fine-loamy,mixed,frigid family of the Mollic Haplargids	
																			X			Loamy-skeletal,mixed, frigid family of the Mollic Haplargids	

Communities	Durargids			Argi-xerolls
	Fine-loamy,mixed,frigid family of the Haplic Mollic Durargids	Fine,mixed,frigid family of the Mollic Durargids	Fine-loamy,mixed,frigid family of the Mollic Durargids	Fine-loamy,mixed,frigid family of the Calci Argixerolls
A. nova				
A. nova/ A. inerme				
A. nova/ A. confertifolia			X	
A. nova/ Stipa comata				
A. pygmaea				
A.tridentata/ C.v. var.*puberulus*				X
A. tridentata/ Stipa comata				
A. confertifolia				
A. confertifolia/ Eurotia lanata				
C.v. var. *puberulus*				
Eurotia lanata				
Descurainia sophia				
Grayia spinosa/ A. spinescens				
J. osteosperma				
J. osteosperma/ A. nova			X	
J. osteosperma/ A. tridentata				
J. osteosperma/A. nova/ A. confertifolia				
*J. osteosperma/ A. nova/*rock				
J. osteosperma/ A. inerme				
J. osteosperma/ C. intricatus				
P. monophylla/ J. osteosperma	X	X		
P. monophylla/J.osteo-sperma/A.nova/A.inerme				

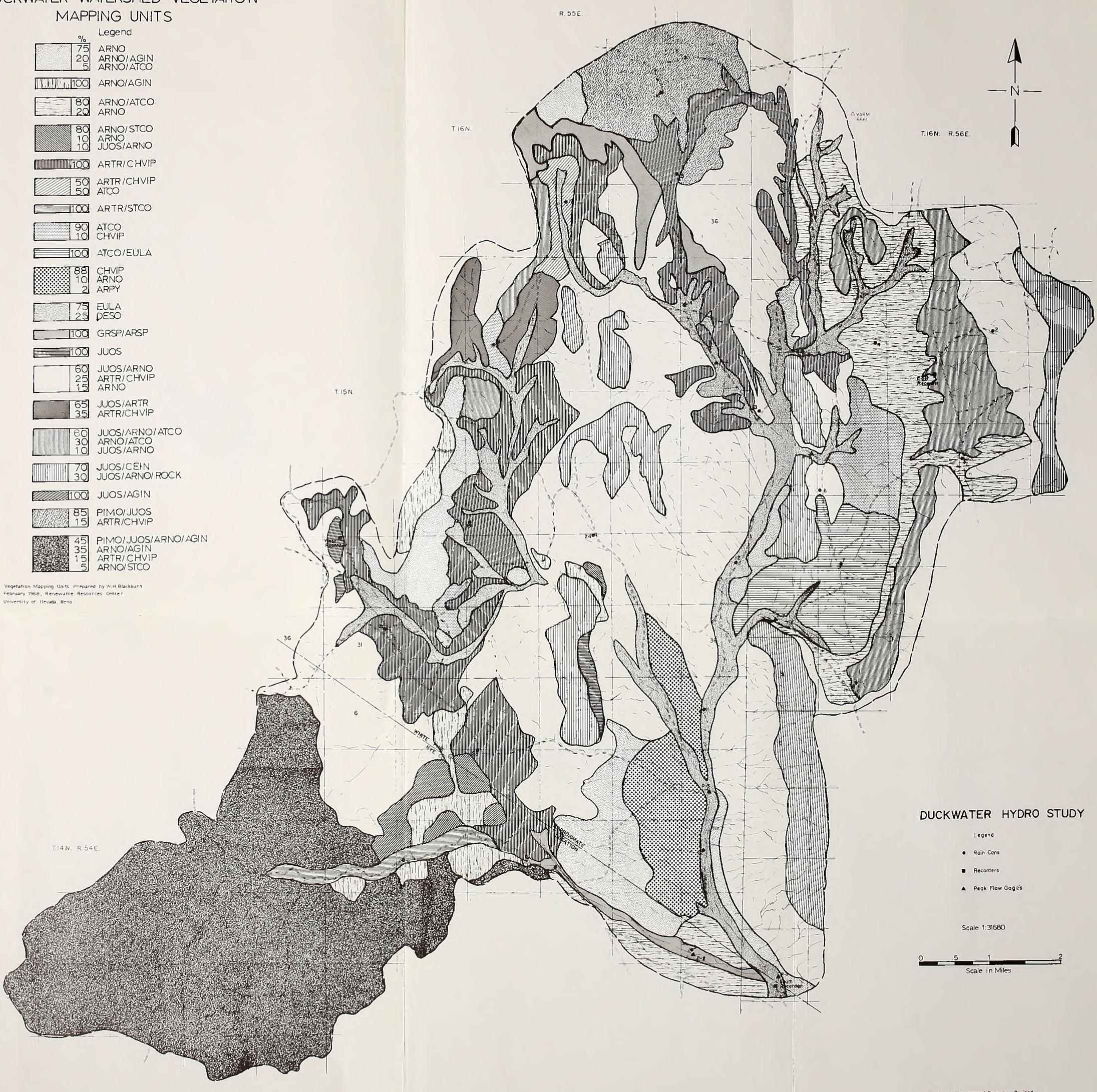
APPENDIX D - DUCKWATER PLANT COMMUNITIES
MAP LEGEND

DUCKWATER WATERSHED VEGETATION MAPPING UNITS

Legend

%	
75	ARNO
20	ARNO/AGIN
5	ARNO/ATCO
100	ARNO/AGIN
80	ARNO/ATCO
20	ARNO
80	ARNO/STCO
10	ARNO
10	JUOS/ARNO
100	ARTR/CHVIP
50	ARTR/CHVIP
50	ATCO
100	ARTR/STCO
90	ATCO
10	CHVIP
100	ATCO/EULA
88	CHVIP
10	ARNO
2	ARPY
75	EULA
25	PESO
100	GRSP/ARSP
100	JUOS
60	JUOS/ARNO
25	ARTR/CHVIP
15	ARNO
65	JUOS/ARTR
35	ARTR/CHVIP
60	JUOS/ARNO/ATCO
30	ARNO/ATCO
10	JUOS/ARNO
70	JUOS/CEHN
30	JUOS/ARNO/ROCK
100	JUOS/AGIN
85	PIMO/JUOS
15	ARTR/CHVIP
45	PIMO/JUOS/ARNO/AGIN
35	ARNO/AGIN
15	ARTR/CHVIP
5	ARNO/STCO

Vegetation Mapping Units Prepared by W.H.Blackburn
February 1968, Renewable Resources Center
University of Nevada, Reno



DUCKWATER HYDRO STUDY

Legend

- ● Rain Gons
- ■ Recorders
- ▲ Peak Flow Gage's

Scale 1:31680

0 .5 1 2

Scale in Miles

Bureau of Land Management Basic map Revised
October 1966 by R.G.S. State Office Reno, Nevada